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ITS STRUCTURE AND FUNCTIONS

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UNITED STATES
DEPARTMENT OF AGRICULTURE
MISCELLANEOUS PUBLICATION No. 88

Issued September 1, 1930
Revised December 15, 1933

The UNITED STATES DEPARTMENT of AGRICULTURE

Its Structure and Functions

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Office of Information

WITH THE ASSISTANCE OF OFFICIALS
IN ALL THE BUREAUS AND OFFICES
OF THE DEPARTMENT

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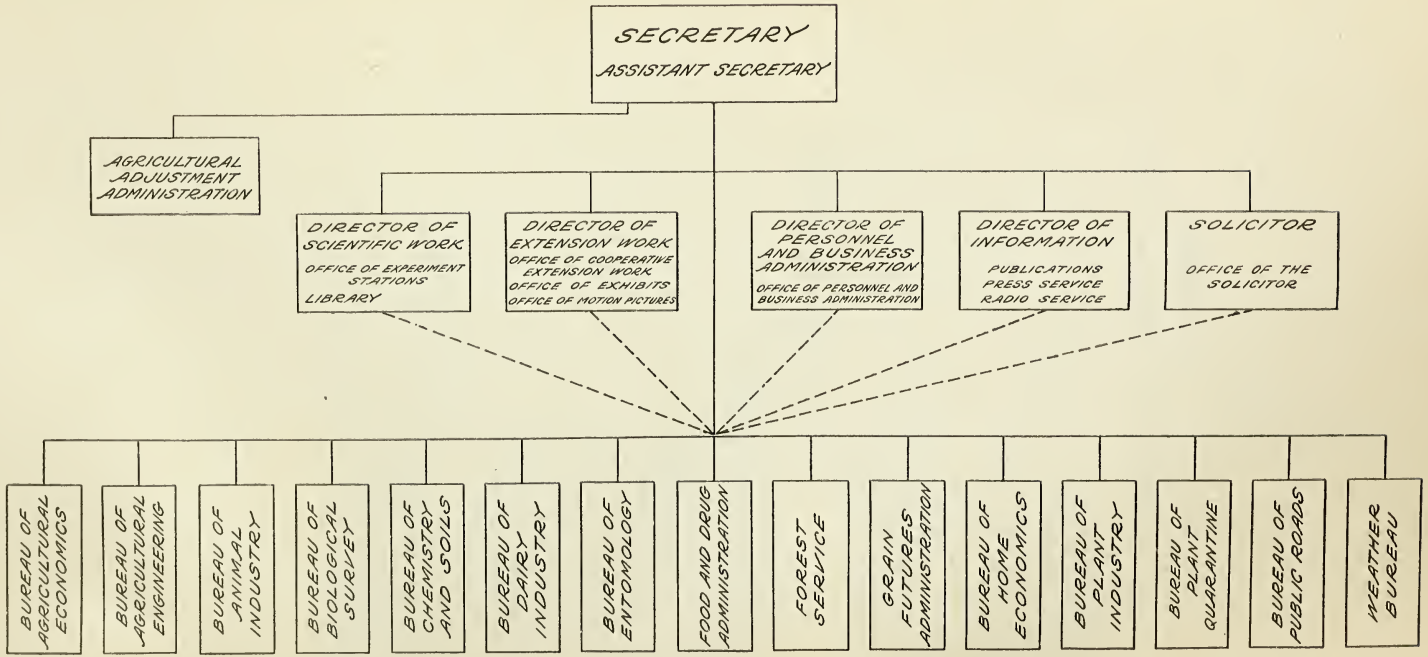
ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE



THE DEPARTMENT AS A WHOLE

INTRODUCTION

Every year adds new chapters to the story of the United States Department of Agriculture. Change and development in the Department are more rapid today than ever before. This compilation is intended to answer questions that pour into the Department ceaselessly, and to sketch in broad outlines the growth, structure, and present functions of the organization. Though nearly everyone knows that the Department exists primarily to advance the welfare of agriculture in all ways consistent with the welfare of the community as a whole, few appreciate the variety of the tasks that this duty imposes. Nor does the public generally realize the character and value of the practical help it may obtain from the Department for the asking. This lack of knowledge about the Department lessens the potential usefulness of the institution and sometimes deprives the Department of needed outside cooperation.

In the first half century of our national life the Federal Government gave little practical aid to agriculture. John Adams as early as 1776 introduced in the Continental Congress two resolutions relating to agriculture. The first proposed the encouragement of the production of certain agricultural commodities, and the second recommended that the Colonies take early measures for erecting and establishing in every Colony a society for the improvement of agriculture. George Washington proposed Government aid to agriculture in his first annual message to Congress; but at that time he simply suggested that it should be encouraged in a general way along with commerce and manufactures. He had progressed far beyond that point by 1796, when, in his last annual message to Congress, he remarked that as nations advance in population the cultivation of the soil becomes more and more an object of public patronage. "Institutions for promoting it [agriculture] grow up, supported by the public purse; and to what object can it be dedicated with greater propriety?"

Nothing came of these proposals. Twenty years passed before any further definite recommendations were made for Federal assistance to agriculture. Then in 1817 the Berkshire (Mass.) Association for the Promotion of Agriculture and Manufacturing petitioned for a national board to help agriculture and manufacturing. This proposal likewise came to nothing.

During the next 20 years the activity of Congress with regard to agriculture was practically limited to the appointment of an

Agricultural Committee in the House in 1820 and the appointment of a similar committee in the Senate in 1825. Not until 1839 were Federal funds specifically appropriated for agricultural services. That year, however, was epochal, for it saw the appropriation by Congress of $1,000 for collecting and distributing seeds, prosecuting agricultural investigations, and procuring agricultural statistics. From this small beginning developed a great national institution for agricultural research and service.

WORK STARTED IN PATENT OFFICE

Originally the Federal Government's agricultural services were carried on under the Commissioner of Patents, then an official of the Department of State. In colonial times, Benjamin Franklin, when he was in England as agent of the Colony of Pennsylvania, sent home silkworm eggs and mulberry cuttings to start silk growing, and also specimens of seeds and plants that he thought might be adapted to this country. This seems to have been a precedent for American consuls abroad, who, after the Revolution, followed his example, at first sporadically and later as a regular duty. Jefferson, as the first Secretary of State, took great interest in the introduction of plants and animals. Henry L. Ellsworth, Commissioner of Patents, undertook to distribute the specimens sent here by our agents. It was on Commissioner Ellsworth's recommendation that Congress made the $1,000 appropriation just mentioned. Succeeding commissioners continued the work. In 1849 the Patent Office was merged with the Department of the Interior, which had been set up in that year. Federal aid to agriculture was administered through the Patent Office from 1839 to 1862, when Congress took a great step forward by creating the Department of Agriculture, and by passing the Morrill Act, granting lands for the endowment of State agricultural colleges. It is significant of the growing interest in agriculture as a matter of national concern that these epoch-making steps were taken during the Civil War. The appropriations for agriculture were increased during the Civil War and grew rapidly thereafter.

LINCOLN SIGNED ACT IN 1862

The act creating the Department was signed by President Lincoln on May 15, 1862, and in that year $64,000 was appropriated for agricultural purposes.

From 1862 until February 1889 the Department was administered, not by a Secretary of Cabinet rank, but by a Commissioner of Agriculture. In 1889, however, agriculture was given the recognition of a seat in the President's Cabinet. Norman J. Colman, previously commissioner, became the first Secretary of Agriculture. Succeeding Secretaries were: Jeremiah M. Rusk (1889–93), J. Sterling Morton (1893–97), James Wilson (1897–1913), David F. Houston (1913–19), E. T. Meredith (1919–21), Henry C. Wallace (1921–24), Howard M. Gore (1924–25), W. M. Jardine (1925–29), Arthur M. Hyde (1929–33), Henry A. Wallace (1933–).

SCOPE OF THE ORGANIC ACT

The act creating the Department of Agriculture directed it to acquire and diffuse useful information on subjects connected with agriculture in the most general and comprehensive sense. Cooperation between the Department and the land-grant colleges was provided for in the Morrill Act, passed at the same time. In 1887 came the Hatch Act, establishing agricultural experiment stations. The development of these stations necessitated the creation of an Office of Experiment Stations in the Department of Agriculture to supervise the expenditure of the Federal appropriations for experiment-station work.

From 1890 on, the Department's duties and responsibilities increased rapidly. Existing units of the organization were merged and new units created to carry on research, service activities, and regulatory-law administration. Cooperative extension work in agriculture and home economics was provided by the Smith-Lever Act of May 8, 1914, under which a nation-wide extension service was set up. Subsequent legislation provided increased extension funds. In 1889 the Federal appropriation for agriculture totaled nearly $2,000,000. By 1917 the figure had risen to approximately $30,000,000 annually. In the fiscal year ended June 30, 1933, money expended for Department activities, including road building, totaled $252,861,396. Of this amount $70,134,656 was for the general work of the Department, and $182,726,740 for emergency activities and road construction.

In the Patent Office period, the agricultural work sponsored by the Federal Government was done by a commissioner and a few aids. The Department now has, for both emergency and regular activities, about 8,600 employees in the District of Columbia, and about 24,125 at 1,451 field stations. Its field staff reaches into all the States and into Alaska, Hawaii, Guam, Puerto Rico, and the Virgin Islands. Representatives of the Department are stationed in Europe, South America, and Asia.

THE PRESENT STRUCTURE

The United States Department of Agriculture is one of the 10 major executive departments of the Federal Government. Its affairs as a whole are supervised and controlled by the Secretary of Agriculture. He formulates and establishes its general policies. His extradepartmental functions include contacts with Congress, to secure necessary appropriations and to advise regarding pending agricultural legislation; contacts with other executive departments, to coordinate interdepartmental activities and to avoid duplication in work; and membership on numerous boards and commissions, such as the Executive Council, the Forest Reservation Commission, and the Migratory Bird Conservation Commission.

In his task of supervising the work of the Department, the Secretary is assisted by a general administrative staff, including an Assistant Secretary, four directors of principal types of work, and a

solicitor. The Assistant Secretary aids in the general supervision of the Department and acts for the Secretary in his absence. In the absence of both the Secretary and Assistant Secretary, the Chief of the Weather Bureau becomes the Acting Secretary of Agriculture.

FUNCTIONS OF THE DIRECTORS

Each of the four directors supervises the work of the Department pertaining to his special sphere, and reports directly to the Secretary. There are the Director of Scientific Work, the Director of Extension Work, the Director of Personnel and Business Administration, and the Director of Information. In many cases the responsibilities of the directors are connected with many of the Department's bureaus and sometimes with them all. Their function, consequently, consists largely in coordinating the various activities so as to avoid duplications, to save time and money, and to forward a sound agricultural program. In addition to this general function, each of the directors has an organization under his immediate control. Thus the Chief of the Office of Experiment Stations reports to the Director of Scientific Work. The Director of Extension Work has under him the Office of Cooperative Extension Work, the Office of Motion Pictures, and the Office of Exhibits. The Director of Personnel and Business Administration is in charge of the offices dealing with finance, personnel, salary classification, department organization, and general business operations. The Director of Information has immediate charge of the Office of Information, comprising the Division of Publications, the Press Service, and the Radio Service. The Solicitor, who is legal adviser to the Secretary, has a large staff of assistants.

MAJOR DEPARTMENTAL UNITS

The new Agricultural Adjustment Administration is supervised by an Administrator who is responsible directly to the Secretary of Agriculture. The other major departmental units, each supervised by a chief who reports directly to the Secretary, are: Bureau of Agricultural Economics, Bureau of Agricultural Engineering, Bureau of Animal Industry, Bureau of Biological Survey, Bureau of Chemistry and Soils, Bureau of Dairy Industry, Bureau of Entomology, Food and Drug Administration, Forest Service, Grain Futures Administration, Bureau of Home Economics, Bureau of Plant Industry, Bureau of Plant Quarantine, Bureau of Public Roads, and Weather Bureau. These bureaus are subdivided into units for convenience in dealing with specialized work. All the bureaus and offices are served by a central library.

The work of the Department is coordinated with the activities of the State colleges and experiment stations. In some cases this cooperation is made binding by formal agreement or by the control of funds, while in other cases the cooperation is voluntary. Thus the Secretary of Agriculture and the executive committee of the Association of Land-Grant Colleges appoint a joint committee to work with the Director of Scientific Work and the Office of Experiment Stations to correlate the scientific research of the Federal department and the State research agencies. Extension activities of

the Federal and State organizations are correlated by the Director of Extension. By voluntary action, those in charge of publication, press, and radio relationships of the colleges and the Director of Information of the Department try to avoid duplications of endeavor and jointly plan special programs; recently information on agricultural-adjustment programs—discussed later in this publication—has been definitely correlated on a Federal-State basis.

In general, the United States Department of Agriculture centers effort on national problems, interstate problems, or problems the solution of which may require facilities not possessed by the States. The State colleges, experiment stations, and State departments of agriculture deal with the more localized problems. This general method of working is again departed from somewhat so far as the emergency agricultural-adjustment programs are concerned.

UNITY OF THE DEPARTMENT'S ACTIVITIES

A full description of so large and complex an organization as the United States Department of Agriculture would involve much discussion of American agriculture, for the Department is intimately linked with our farming system. It is a service institution for the entire Nation, with many duties affecting nonagricultural interests. This recital is necessarily confined to the more outstanding features of the Department.

The original task of collecting and issuing agricultural information, done mostly from a single office, has broadened until today the entire continental United States, the insular possessions, and many foreign countries serve as the Department's laboratory. The collection of facts has developed into technical and scientific research in the biology of plants and animals. The dissemination of information now necessitates the printing of 25,000,000 copies of publications annually. It requires the work of a press service, a vast extension service, an office of exhibits, an office of motion pictures, and a radio service. The Department's work in plant breeding, in introducing valuable plants from abroad, in excluding or eradicating plant and animal pests, in disseminating vital weather information, in economic investigations, in livestock improvement, in forestry, in the prevention of soil erosion, in soil classification, and in many other fields develops new knowledge faster than it can be published. To the original program have been added such duties as the issuing of weather forecasts and warnings, the building of roads, the enforcement of numerous regulatory laws, and the grading and standardization of commodities.

SIX GENERAL CLASSES OF WORK

All the Department's ordinary activities—i.e., not including emergency adjustment work—may be divided roughly into six general classes: (1) Research; (2) extension and information; (3) eradication or control of plant and animal diseases and pests; (4) service activities, such as weather and crop reporting, and forest and wildlife refuge administration; (5) the administration of regulatory laws; and (6) road construction. These functions are closely inter-

related and interdependent. Research, for example, is not complete in itself. Knowledge gained must be communicated to the public, used in eradicating plant and animal pests, and incorporated in regulatory-law administration. It is as essential a duty of the Department to promote the application of science as it is to increase scientific knowledge. These manifold duties, though not the result of a preconceived plan, did not come about fortuitously. They developed from small beginnings in directions determined by agricultural and national wants and by the growth of science. The Department is not a mechanical creation but a living institution evolving structurally and functionally in a changing world.

While the Department of Agriculture is called the farmer's branch of the Government, actually it is much more. Benefits arising out of the Department's expenditures go to the entire public. Much of its work promotes public health and well-being. Its research, by helping farmers to grow better crops and livestock, to reduce their costs, and to market their products more efficiently, benefits the consumer as well as the producer. A few examples will show why practically everyone is interested in the Department's activities.

The public has a vital interest in the Federal meat-inspection service, which costs more than $4,750,000 annually. This service maintains a high standard of sanitation in packing plants, and aims to insure safe animal products. The research and the veterinary work of the Department promote public health by eradicating animal diseases or reducing their prevalence. The public is interested in the efficient and impartial enforcement of various regulatory laws. Through enforcement of the Food and Drugs Act, and Tea Import Act, the Caustic Poison Act, the Import Milk Act, and similar laws, the public is protected against unwholesome or adulterated foods and drugs, inferior disinfectants, and ineffective insecticides.

The weather service is indispensable to innumerable commercial and industrial enterprises, as well as to agriculture. Building contractors save on cement jobs by heeding frost forecasts. Shippers of perishable products prevent losses in the same way. Flood and storm warnings often have extreme commercial importance. Weather reports are indispensable for navigation and aviation.

Forest conservation and wild-life protection are of interest and value to the entire population. The Department administers national forests with a total area of approximately 160,000,000 acres, including about 20 percent of the forested land of the country. It cooperates with the States in protecting from fire some 240,000,000 acres of privately owned and State owned forest lands; it also cooperates in tree planting and in the management of farm wood lots; and it engages extensively in forest research. These activities are of immense value to the public as measures for the perpetuation of the country's forest resources.

The Bureau of Home Economics does work of general benefit by selecting well-balanced diets, determining ways of utilizing new foods, and finding new uses for textiles; especially has the Bureau's recent work in teaching relief agencies and families out of work or on reduced incomes how to secure adequate diets at the smallest possible cost been of value to the entire Nation. Economic information about agriculture is needed by business men and farmers alike.

Plant importations, pest eradication or control, studies in the life histories and habits of insects, wild-life conservation—these and many other phases of the Department's work have widespread interest and value.

The largest single item of the Department's expenditures is for the improvement of roads. In the fiscal year 1933, more than 72 percent of the total expenditure was devoted to this purpose. Under this act the Department cooperates with the highway department of each of the States in the construction of roads included in the Federal-aid highway system. The Federal-aid system consists of the most important interstate and intercounty roads. Its improvement benefits city dwellers as much as farmers.

RESEARCH

Research, of course, is fundamental in the Department's work. All interests today recognize that the Federal Government should promote agricultural science. It is a public, rather than a private, function because agricultural research does not ordinarily attract private enterprise. Individuals and corporations seldom have the public spirit, the scientific interest, or the financial resources to conduct agricultural research efficiently. There are exceptions. Sir John Lawes developed important new knowledge about fertilizers and soil treatment at a private experiment farm at Rothamsted, England, without government support or encouragement. But the expense and uncertainty involved in agricultural research are greater than private enterprise can usually stand. Not to carry it on, however, would mean neglecting one of the greatest sources of national wealth.

In the United States the first steps in agricultural research were begun by some of the State universities and by some of the endowed colleges in the universities. Since the middle of the nineteenth century the Federal Government has been its chief supporter. Research now dominates all the work of the Department, its service, regulatory, and educational activities as well as its scientific projects. Useful service must be grounded in scientific knowledge. Science furnishes the basis for the practical help the Department gives farmers, timberland owners, homemakers, handlers and processors of farm and forest products, marketing agencies, manufacturers, business men, and consumers.

We may distinguish between research for more or less well-defined practical objects, and fundamental research for the discovery of basic facts and principles. The first type may be undertaken to throw up a hurried defense against diseases and pests, to develop plant varieties or strains of livestock suited to particular conditions, or to find new uses for crop byproducts. Fundamental research is not always directed toward any clearly defined practical goal. It explores physical or biological phenomena, primarily to increase the sum of knowledge rather than to attain any specified tangible advantage. This does not mean that fundamental research is not practical. It is practical in the highest and most permanent sense. Time and again fundamental research has developed facts or principles of revolutionary practical importance.

Both types of research are carried on in the Department. Naturally research for specified objects bulks larger than fundamental research in the scientific program, because research funds are usually appropriated for specific purposes. Yet much fundamental research is done, because it is often impossible to solve problems by short-cut methods. Fundamental studies to unravel nature's secrets sometimes prove more practical than work less broadly conceived.

UNEXPECTED RESULTS OFTEN IMPORTANT

In practice the line between these two types of scientific activity is not always clear. Work started for a particular practical purpose may fail until its scope has been widened to include a study of the basic elements involved. Often the byproducts of research outshine its contemplated results. The final test of science is practice, but it is not well to demand the test too soon. Years may pass between the discovery of a truth and its application. Scientific inquiry is essentially a long-time activity that can be truly appraised only on a long-time basis. A research policy that considered only immediate objects, and lost sight of the fact that much important knowledge is not recognized as such at first, would be shortsighted. Research probes into the unknown. By its nature it cannot be restricted to forseeable objects.

Departmental research in the phenomena of roundworm infestation of swine led to the development of a swine-sanitation system that saves the Corn Belt farmers who follow it probably a million dollars a year. The control of hog cholera followed the discovery that the disease is caused by a filterable virus. Fundamental research into the mosaic diseases had far-reaching practical significance. The Department demonstrated that the flowering and the vegetative growth of plants are controlled by alternations of light and darkness, and that the time of flowering can be controlled by changing the length of periods of exposure. This discovery opened great possibilities in the control of plant life. Many other examples might be given to show how fundamental research in the Department has yielded practical results. Increasing importance attaches to research that discloses its ultimate value only when pooled in the common fund of scientific knowledge.

Specialized research is done in nearly all the Department's bureaus, and touches every phase of agriculture as well as many related problems. This work deals with the selection and breeding of superior plants, the development of new varieties, and the biology of plant diseases. It studies how to increase the weight of the beef animal, and the milk production of the dairy cow. It ascertains facts about the nutritive value of feeds. It investigates problems of soil composition and fertilizer requirements. It develops poisons, insecticides, and serums for use in the war against pests and parasites. It goes into the economic problems of the farmer, into his social and community problems, into his transportation problems, into his problems as a consumer. It studies wild life, so that beneficial species may be protected and conserved or reared under domestication, and harmful species controlled. It deals with engineering

problems, such as those connected with irrigation, with the prevention of soil erosion, with highway construction, and with the efficient use of farm machinery. It studies how best to grow and protect our forests, how to make them more productive, how best to utilize the country's forest resources, and the effects of forests upon climate, stream flow, and erosion.

It embraces also problems of importance to the homemaker, such as those connected with diet, cooking, clothing, house equipment, and the expenditure of the family income. It carries on work in industrial chemistry, to promote an increased utilization of farm products and farm byproducts. It inquires into the purity and healthfulness of food and drugs offered for sale in interstate commerce. It studies the weather, for the protection of a thousand agricultural and industrial interests. All the main branches of science, particularly chemistry, biology, and physics, are represented in the Department's research activities, which will be described in more detail in sections to follow on the various Department bureaus and offices.

PUTTING SCIENCE INTO PRACTICE

Service functions grow out of the Department's research. Knowledge gained by the study of animal diseases and parasites is the basis of control measures. Diagnosis of foot-and-mouth disease on its rare appearances in this country has led to its prompt and complete eradication. The same is true of the infectious poultry malady, European fowl pest, which appeared in the United States in 1924 and was eradicated in 1925. It made a second appearance in June 1929, but prompt diagnosis led to its speedy suppression. Research helps to eradicate or prevent bovine tuberculosis, tick fever, hog cholera, sheep and cattle scabies, diseases of animals on fur farms, and various other maladies. Several years ago the Department proved that anaplasmosis, a disease of cattle, exists in this country, and the knowledge led to experimental methods of control and treatment. A study of the so-called mosaic diseases of tobacco, tomatoes, cucumbers, potatoes, sugar beets, corn, wheat, sugarcane, and many other cultivated crops, including fruits, resulted in the development of resistant varieties and the establishment of these varieties in threatened areas.

ACCOMPLISHMENTS OF ENTOMOLOGY

The cotton bollweevil, one of the worst insect pests, has been brought under a large degree of control by thorough dusting of the cotton plants at appropriate times with powdered calcium arsenate. The discovery of the susceptibility of the insect to certain arsenical poisons gave cotton growers a means of decreasing its injury to the cotton crop even during the worst bollweevil years. The result is a net benefit, averaging $15 an acre.

Curly top, a serious malady of the sugar beet, is attributed to a small leafhopper. This pest normally migrates from the desert into beet fields, carrying with it a virus which produces the malady of sugar beets. An entomologist trained also in ecology discovered

the influences which result in the migration of the insect and the conditions under which migration is likely to take place. Hence the Department can inform growers, in time for the information to have a bearing on their sugar-beet planting, whether an abundant or a light infestation of the pest that causes curly top is likely to occur during the coming season. Recently Department scientists developed a variety of sugar beet which is resistant to the curly top disease.

CORRELATING DISEASE KNOWLEDGE

That plants, like animals, are subject to disease has been known from the beginning of history. The Bible frequently refers to "blights and mildews" of plants, and Aristotle, B.C. 300, speaks of the rust of wheat. It is only within the last hundred years that the fundamental discovery was made of the relation of fungi, bacteria, and other microscopic organisms to plant diseases. Pear blight was the first bacterial disease of plants to be so recognized. Why the disease often developed almost at once on the whole bloom of the tree, however, was still a mystery. One morning, in the Department's grounds at Washington, a member of the Department saw a bee dive into a pear blossom. He caught the insect, removed certain adhering substances from its head and body, and looked at these substances through a microscope. He found the pear-blight organism. Thus was established the important fact that a bacterial plant disease can be carried from one plant to another through the agency of an insect, and the simultaneous development of pear blight on many blossoms was explained.

This discovery was followed 2 years later by the discovery that splenetic or tick fever is transmitted by the cattle tick. The joint responsibility of bacteria and parasites in the causation of certain mysterious plant and animal diseases was revealed and a basis laid for effective control of such diseases. Through quarantine action in the Southern States cattle ticks were eradicated from large areas and cattle freed from a disease that had formerly caused heavy losses. Out of 985 counties that were quarantined when systematic tick eradication began in 1906, only 89 still had to be kept in quarantine at the end of 1933. This is one of the most outstanding successes of regulatory action based on scientific discovery in the Department.

Benefits derived from the revelation that plant diseases may be transmitted by insects and other invertebrates have not been confined to agriculture. In the tick-fever investigation it was demonstrated that the actual cause of the disease is a micro-organism found in the blood of infected cattle, and that the cattle tick is the only means whereby the disease can be transmitted. This proof that a protozoan disease may be transmitted exclusively by an intermediate host or carrier led to the knowledge that yellow fever, malaria, typhus fever, African sleeping sickness, Rocky Mountain fever, nagana, and other diseases are similarly communicated. It made possible the control of yellow fever in the Panama Canal Zone. Many plant diseases, including sugarcane mosaic and sugar-beet curly top, are transmitted by insects.

TRIUMPHS IN PLANT BREEDING

Another branch of study in the Department that has had important practical consequences, including the enactment and enforcement of certain regulatory laws, is plant breeding. In the strict sense, plant breeding is a comparatively new development, though plant improvement has been going on since man first became interested in plants. Methodical plant breeding was unknown before the discovery that plants are male and female.

This fact, though previously suspected, was not definitely established until less than 2 centuries ago. The greatest progress in plant breeding is a development of the last 20 or 30 years. Plant breeding in the Department of Agriculture has developed plant varieties that thrive where the varieties previously known could not, and has improved the quality, the yield, the disease resistance, and the climatic adaptability of many crops.

Among early triumphs in this field was the discovery of important facts about cotton wilt and about the nematode diseases of cowpeas and other leguminous crops. Through plant breeding the potato industry has been protected and the sugar industry of Puerto Rico and Louisiana reestablished. Plant breeding has pushed up the northern boundary of spring wheat and promises to do the same for winter wheat. The discovery that resistance to disease and to climatic conditions is a genetic character which may be bred into or bred out of plants constitutes the justification for such legislation as the Federal Seed Act. This law requires that all seed of alfalfa and red clover imported into the United States shall be artificially colored, so that the purchaser may know whether he is buying seed of domestic or foreign production.

PLANT IMPORTATIONS

Research and service activities are combined in the introduction of foreign plants, which has been a major function of the Department ever since it was created. As already noted, plant introduction long antedates the creation of the Department. It was practiced by the early settlers, and was promoted after 1839 through the Patent Office. All our field crops, except tobacco and corn and a few lesser crops, have been introduced from foreign countries. The original home of the potato is below our southern boundary. In the last 30 years or so plant-introduction work in the Department has been systematized and scientifically controlled, and its value much increased. Citrus fruits, durum wheat, alfalfa and sudan grass, acala cotton, numerous important varieties of soybeans, japanese plums, vinifera grapes, persian walnuts, figs, and many other valuable crops have been introduced.

Highly trained plant explorers seek valuable new plants in all parts of the world. These plants, when received into the United States, are tested and cultivated to determine their importance to American agriculture. Entomologists and pathologists carefully inspect each shipment for pests and signs of disease. All imported seeds are fumigated regardless of their origin, and many bulbs are treated with hot water to kill nematodes. Specimens from countries

where especially dangerous pests or diseases occur are given additional treatment. Quarantine houses are maintained where the imported plants may be grown under observation, to disclose any condition not apparent on their arrival. In short, botanical and pathological studies go hand in hand with the propagation and establishment of the new varieties. Some idea of the scope of the Department's plant-introduction work is evident from the fact that the serial numbers given to the imported specimens now run above 100,000. The numbering system was started about 25 years ago.

NEW PROBLEMS FROM PLANT IMPORTATIONS

Plant-introduction work involves a combination of research and service in many ways besides the testing and establishing of plant immigrants. It raises new problems in human nutrition, in animal husbandry, in commodity standardization, inspection, and marketing, in soil treatment, in the distribution of types of farming, and in insect and disease control—in all of which matters the Department is vitally concerned. Imported plants have furnished the basis for some of the most successful experiments in plant breeding by the Department and the State experiment stations. Thus, Kanred wheat, recognized as strictly an American variety, was derived by selection at one of the State stations from a strain imported by the Department. The introduction of sudan grass as a forage crop in our semiarid regions stimulated farming where formerly it had not thrived, and had consequences that touched practically all phases of the Department's work.

COMBINING RESEARCH AND REGULATORY WORK

Research and regulatory work interact, as is shown, for example, by the course taken following the discovery that white pine blister rust lives alternately on the white pine and on currant and gooseberry plants. This discovery led the Department in 1917 to establish a quarantine line through the Mississippi Valley so as to prevent a further westward movement of dangerous host plants from the eastern white pine region. The measure was effective in checking the westward spread of the rust. In like manner the discovery by European investigators about 1865 that the common barberry is the alternate host of the black stem rust of cereals led to regulatory activities. In 1929 the Department demonstrated that the baffling phony disease of peach trees, which is prevalent in Georgia and to a lesser extent in Alabama and Mississippi, and is increasing in severity, is a communicable root disease. This knowledge likewise became the basis of quarantine action.

LONG-DISTANCE SHIPMENT OF PERISHABLES

Long-distance shipments of fruits and vegetables, and extensive Federal services connected therewith, are an outgrowth of research done in the Department of Agriculture in cooperation with the State agricultural colleges and the experiment stations. Fifty years ago most of the commercial peach orchards, for example, were in a narrow fringe near the Middle Atlantic tidewater from Long Island Sound to Cape Charles, and in a similar narrow fringe on the south shore of Lakes Ontario and Erie and on the eastern shore of Lake

Michigan. They were there because the peaches grew within a 24-hour ride of the ultimate consumer. Twenty-four hours was then about as long a life as the well-ripened peach had. About 1890 a refrigerator car suited to the transportation of fruits and vegetables was developed, and a refrigerator-car icing service was established on the sleeping- and dining-car plan. This new system, which soon covered the entire country, largely abolished distance as a limiting factor in the production of fruit and vegetables for domestic consumption and gave a nation-wide market to an industry formerly dependent on local distribution.

SOME RECENT ACHIEVEMENTS

The stream of research accomplishments continues to flow. In a single year (1932) the Department reported dozens of achievements important as contributions to the country's economic welfare, as well as to the growth of science. It may be useful to mention just a few of these.

Investigators discovered that endemic typhus fever, a debilitating disease of man which had been increasing in the eastern and southern part of the country, is transmitted by a mite that attacks the tropical rat. They found also that a small gnat caused pink eye or conjunctivitis, a serious scourge in many parts of the United States, especially among school children. The Department developed a curly top resistant variety of sugar beets which under curly top conditions produced on the average 4½ tons more beets per acre than did the commercial strains used locally. Sugarcane investigations indicated means of decreasing the deterioration of mill cane, of decreasing losses in the recovery of sugar, and of extending the length of the season during which cane may be milled in Louisiana.

In cooperative experiments at the California Experiment Station, early-maturing hybrid selections of rice produced better yields than the principal early-maturing varieties, Colusa and Onsen, now grown commercially. The Department developed a new early wilt-resistant tomato named "Pritchard" that appears to rank with Marglobe in excellence and probable future importance. In recent years in the United States the annual injury to beans from seed-borne diseases has run as high as $4,000,000. In 1931 the Department demonstrated that the use in the Eastern States of seed from the Western States will greatly reduce seed-borne diseases. Strains of sweet corn resistant to bacterial wild, a disease that caused severe damage in 1931, were produced in cooperative experiments with the Indiana State Experiment Station.

Two pedigreed varieties of fiber flax, developed by years of selection, proved superior when tried out in field tests in eastern Michigan in comparison with other fiber flax grown for seed and upholstering tow. A sudden and severe outbreak of downy mildew on hops in Oregon and Washington required the aid of Department scientists. Bordeaux mixture proved an effective control agent. Strains of tobacco resistant to black root rot were developed by the Department in cooperation with State agencies.

The Department demonstrated that there is a marked difference in the vitamin content of hays. Cows fed for long periods on in-

ferior roughage decline in general health, reproductive ability, and milk production. Investigators found that dairy-barn temperatures affect milk yields; temperatures maintained between 45° and 60° F. gave the best results under northern winter conditions. Animal parasite studies conducted with the Oklahoma station disclosed for the first time that three species of ticks can transmit anaplasmosis, an infectious febrile disease of cattle, from infected to susceptible animals. Investigations revealed that a species of roundworm probably causes certain lesions in the livers of swine. Such lesions result in the condemnation of the livers at federally inspected slaughtering establishments.

Asparagine, a rare and expensive amino acid formerly obtainable only from Europe, can now be produced in this country as a result of biological investigations in this Department. Asparagine is valuable in investigations of bovine tuberculosis, the organisms of which make exceedingly good growth on culture media containing asparagine.

Discoveries by this Department have helped to place the United States well on the road to independence in fertilizer materials. So far as nitrogen is concerned, the monopoly is over; research in the Department fostered the production in the United States of cheap nitrogen from the air by a synthetic ammonia process. Though this country continues to import most of its potash, it has a substantial and growing potash industry, and American production promises shortly to be the controlling factor in domestic prices.

A new process has been developed and successfully tested whereby with the use of ammonia and carbon dioxide, potash and ammonium sulphate can be easily manufactured from polyhalite, the potash mineral recently found in large subterranean deposits in western Texas. If the results of the potash work of this Department were applied to the 1930 bill of $22,000,000 for fertilizer potash, this would represent a saving of $13,574,000.

Two new insecticides, deguelin and tephrosin, may prove valuable additions to the list of organic insecticides that can be used freely on vegetation without injuring it. Chemists discovered these insecticides in several tropical plants, derris root, cube root, and certain species of *Tephrosia*. Rotennone occurs in derris root and in the cube plant. This valuable new insecticide was further developed by the Department's chemists. It is more toxic than pyrethrum to many insects. Various mechanical appliances developed by the Department's agricultural engineers helped to reduce farm costs of production. To combat the European corn borer, engineers devised a simple stalk shaver for cutting cornstalks flush with the ground. They developed experimental machines for applying fertilizers accurately at predetermined rates and in various positions with respect to the seed. Chemical and plant research had demonstrated the importance of this.

Two new fumigants for insects infesting grain and other agricultural products in storage were developed by the Bureau of Entomology and the Bureau of Chemistry and Soils. These fumigants are now widely used throughout the country for treating a great variety of products, including clothing and house furnishings. These new fumigants are the ethylene dichloride-carbon tetrachloride mixture and the ethylene oxide-carbon dioxide mixture.

They are efficient, nonexplosive, and involve little or no risk to the operator.

Light plays an important role in the development of rancidity in foods. This was recently demonstrated by the Department in experiments that led to the granting of a public-service patent to make the discovery available to the American public. The experiments showed that the portion of the spectrum lying between 4,900 and 5,600 Angstrom units, which imparts the color approximately chlorophyll green, prevents or delays rancidity. Temporary storage of some fruits and vegetables in atmosphere relatively high in carbon dioxide is an effective substitute for precooling, scientists discovered. This treatment holds rot organisms in check and delays the ripening process somewhat.

The Department showed how waste and costs may be reduced in handling and transporting fruits and vegetables. In orange shipments from California to eastern markets a new method permits safe shipment with only one reicing in transit instead of the 10 or 12 reicings required under the standard refrigeration previously used. With dilute nitric acid as the pulping agent, the Department developed a process for making high-grade cellulose from bagasse, the waste from sugarcane after the sugar has been extracted.

Work on lignin, a component of all agricultural wastes, showed that several synthetic resins can be produced from it, as can eugenol, the essential constituent of oil of cloves, and vanilin, the flavoring constituent of vanilla. By processes developed in this Department, industrial chemists produced from agricultural wastes in 1932 more than 1,000,000 pounds of furfural. Some 5,000,000 pounds of oat hulls, which would otherwise have been wasted, were thus utilized.

Inulin, the principal constituent of chicory root, is thought to be the most suitable carbohydrate available for the diet of persons suffering from diabetes. Recently the Department devised a method of producing extremely pure inulin by a simple and cheap process, the most suitable source being chicory, now grown in limited quantities in the United States as a coffee substitute. Experiments at the Department's laboratory of fruit and vegetable chemistry at Los Angeles developed a new fruit product, frozen fruit pulp, which promises to afford a new and profitable outlet for fruit heretofore graded low and sold at a low price.

By a process recently developed in the Department, milk sugar can be removed from skim milk without affecting the casein. This process is particularly valuable to the ice-cream industry. Investigations developed means of preventing the crystallization of sugar from cane sirup and of controlling the flavor and color of cane sirup by the use of decolorizing carbon. This was an important step toward the more uniform production of high-quality sirup.

CORRELATING THE RESULTS OF RESEARCH

It is important to correlate not only research activities but research results. The Department carries on investigations in many directions simultaneously; it does not suffice to tell the farmer what is learned in only one or two of these inquiries. He must have the net practical result of them all. He must know how discoveries in one field bear upon discoveries in another, and how new knowledge in general should modify old farm practices. Science progresses by

specialization—by breaking up or analyzing problems into various parts for separate study. But before knowledge thus gained can be put into successful practice, the parts must be put together again. After the analysis of problems, there must be a sythesis of results, in which different kinds of scientific information are assembled for practical application.

Cotton growing in the presence of the bollweevil, for example, is facilitated by three principal methods—the planting of early-maturing varieties, the close spacing and fertilization of the plants to enhance further their tendency to mature early, and the application of poison to kill the insects. Applied singly, these expedients do not give the best results. Early-maturing varieties, if wrongly handled, fail to develop their good qualities in full measure; and poisoning alone, particularly when cotton is low in price, may not pay. Facts learned in many distinct branches of science, notably plant breeding, soil study, chemistry, and entomology, must be cross-fertilized. Furthermore, the practical cotton grower must combine technological principles with economic information. Market conditions sometimes penalize instead of rewarding the grower of superior fiber. Such conditions must be recognized and remedied before technical progress will benefit the farmer as it should.

The task of integrating research results for practical application is one of unending difficulty. Moreover, it is not exclusively the task of research workers or research institutions. It requires the active and informed cooperation of farmers. The Department can express the diverse findings of its numerous related studies only in general recommendations. It is impossible to produce detailed instructions suited to all farms and all conditions. Hence the final touches to the work of combining different types of scientific information, so that each type may be given its due weight in practice, are the duty of the individual farmer. When soil experts, entomologists, chemists, botanists, and economists study different aspects of an agricultural problem simultaneously, they make progress at different rates and the facts they dig up have varying importance. Fitting their contributions together for the test of practices is essentially the task of the practical farmer.

However, the Department tries to meet him halfway. It does so primarily through its extension and information services, which strive constantly to make available a "balanced diet" of scientific information. Extension workers endeavor to see the problems of the farm as a whole, and to suggest cropping and marketing methods in which various branches of knowledge are proportionately represented. They try, above all, to help farmers grasp diverse technical results for themselves. Valuable work to the same end is done by the county agents and the boys' and girls' 4-H clubs. In the Department contacts are made with farmers' organizations, and with other groups interested in applying agricultural science. Members of the Department cooperate with the growers, distributors, and processors of cereals and fibers. They bring the results of nutrition studies to the notice of home makers, merchants, and manufacturers. The Department's studies in the control of soil erosion, land utilization, the utilization of farm byproducts, and other urgent problems involve innumerable outside contacts that help to close the gap between agricultural science and agricultural practice.

THE ECONOMIC SERVICES

Farmers need economic information as well as help in combating insect and other pests and in improving their field crops and livestock. Lacking data on markets and prices, the farmer works in the dark, with small chance to make a profit. This fact, though generally recognized, was formerly not taken sufficiently into account in public services for agriculture. Research was largely concentrated on the technic of production. As production per acre and per man increased and the farm area expanded, surplus problems grew more pressing. Action became necessary to effect a better regulation of supply to demand, and a more orderly flow of production into consumption.

The first requirement was more information about production, stocks, and consumption demands. Progress in statistical science made it possible to satisfy this requirement. Accordingly, the Department developed extensive and varied economic services, in which research was combined with the regular gathering of crop and market data, and with numerous related services, such as commodity grading and standardization, shipping- and receiving-point inspection of farm commodities, seed verification, price analysis, and "outlook" reporting. Farm-management studies were undertaken, whereby general economic information was related to the needs of particular localities and particular farms. In short, the Department began systematically to help the farmer look ahead, and the work soon became a major departmental activity.

In its production studies the Department brings science to the farmer's aid in learning how to grow his various crops. In its economic studies it tries to help him decide what to grow. It endeavors, in other words, to help him establish a good balance among his different crop enterprises and to adjust his production as a whole to market needs. This work is closely linked with the technology of production, because changes in acreage and in livestock breeding accomplish their desired end more surely when the plant varieties grown and the livestock raised are superior types that may normally be relied on for stable performance.

COOPERATION AMONG EXPERTS

Economists and production technicians work hand in hand in the Department's economic services. In crop reporting the economists are aided by weather reports and by reports from the Department's entomologists and plant pathologists so that damage from the weather and from pests and diseases may be more accurately estimated. In farm-management studies, cooperation is necessary among economists, chemists, biologists, animal-husbandry experts, entomologists, and plant-production specialists. Grading and standardization and commodity inspection depend largely on knowledge gained in production research. In the grading of fruits and vegetables, the plant breeder and the plant pathologist assist by developing products adapted to specific requirements. In the grading of meat animals, the animal-husbandry expert tells how to recognize quality factors. Technical information is indispensable in the grading of grain and cotton. Practically all the Department's bureaus

and offices and all its different scientific services join in making its economic work practically useful. Regulatory policy, especially in connection with such laws as the Packers and Stockyards Act, and the Plant and Animal Quarantine Acts, has important economic relationships.

SERVICE PRIMARILY FOR FARMERS

Economic information put out by the Department is primarily for the farmer, though useful to all persons having dealings with agriculture. Reliable information about market prospects helps the farmer to adjust his acreage and his livestock breeding intelligently, and to join with other farmers in concerted action to stabilize production. It also lessens the influence of speculation in the agricultural-commodity markets. Prices stick closer to the supply and demand line when the facts about supply and demand are accurately and generally known. There is then less room for the influence of uninformed opinion or deliberate misinformation. Ultimately, prices depend on tangible and measurable elements in the supply and demand equation. Among these elements production is the most important, and the measurement of production has attained a high degree of accuracy. Progress has been made also in the measurement of demand, which depends on such factors as the general price level, the state of business and employment, and the possibility of substituting one commodity for another in various uses. Light on these factors is a powerful influence in reducing price fluctuations. What bookkeeping is to the individual or to the business corporation, economic information is to agriculture as a whole.

Economic research deals also with such questions as the proper utilization of land, the balancing of the various crops of a farm so as to give the best results, the proper size of farms, the tax problem, the tariff problem, the credit problem, the problem of family living standards, the influence of population movements on agriculture and on economic conditions generally, shifts in types of farming, conditions that justify specialization or diversification, and many other matters. Particularly important are the land-utilization studies, which indicate the best uses for different types of land and disclose the need or lack of need for expansion, drainage, reclamation, and so on.

NEW FARM-RELIEF LAW

Congress recently passed an act for the relief of agriculture which requires the Department to direct and administer a tremendous readjustment in agricultural production with the object of raising the farmers' earnings and restoring a good economic balance between city and country. It demands the good will and cooperation, not merely of farmers, but of processors, retailers, and consumers.

Agriculture has an obstinate surplus problem, a result largely of forces which the farmers could not control. American agriculture before the war was moving away from excessive dependence on the world market. The war reversed this trend. Financial policies after the war strengthened the drift back. Suddenly foreign buying power collapsed. Our farmers could no longer market wheat, cotton, meat products, and other commodities abroad on the scale required

by their production. Unsalable export surpluses backed up into the home market and forced prices down.

Other factors contributed to the distress of agriculture. The world crisis reduced domestic as well as foreign buying power. There was an aftermath of debt incurred during the war-time inflation. Bulking largest, however, was the surplus problem. This is what chiefly explains the disparity between the prices farmers receive and the prices they have to pay. In April 1933 the farm-commodity-price index was 50 percent below the pre-war level, whereas the index of the prices paid by farmers for commodities bought was 3 percent above the pre-war level. The spread shows that agriculture has relatively more overproduction than other industries. It reminds us that profitless export trade means profitless domestic trade.

Reducing production is a costly operation, as manufacturers as well as farmers can testify. Reduction on the scale necessary means risk and expense. Farmers dare not attempt it singly. Accordingly, the new farm law makes it possible for the Government to help them act in concert. It provides various methods. The object is to shrink production until it fits demand. Excise taxes furnish money for payments to farmers who cut their output. This feature of the measure distinguishes it fundamentally from previous relief plans. None of the earlier schemes contemplated the control of production.

The new program does not flout the law of supply and demand. On the contrary it supports and harmonizes with that law. It provides a means of increasing the income of the farmers without creating a new temptation to increase the output. It provides for production control. Generally, the measure seeks to reestablish the relationship that existed before the war between the prices of farm products and the prices of other goods.

This is a program for economic planning, the first of its kind in the Nation's history. By organizing producers for action which they cannot take unaided, it will substitute order for anarchy in agriculture. The details of this new program are reported in a chapter devoted to the Agricultural Adjustment Administration.

REGULATORY-LAW ADMINISTRATION

The Department administers approximately 50 regulatory statutes. The most important are the animal quarantine laws, the Meat Inspection Act, the Virus Serum Toxin Act, the Packers and Stockyards Act, the 28-hour law, the Renovated Butter Act, the Plant Quarantine Act, the Food and Drugs Act, the Tea Importation Act, the Import Milk Act, the Naval Stores Act, the Caustic Poison Act, the Insecticide and Fungicide Act, the Steel Importation Act, the Migratory Bird Treaty Act, the Lacey Act (affecting wild life), the Alaska game law, the Cotton Standards Act, the Grain Standards Act, the Federal Warehouse Act, the Cotton Futures Act, and the Grain Futures Act.

Like its other activities, the Department's regulatory work was developed to meet long-standing public needs or new conditions created by the progress of scientific knowledge and the growth of population and markets. It originated, with the creation of the

Bureau of Animal Industry in 1884, when Congress passed certain legislation to regulate traffic in livestock. Contagious pleuropneumonia was then prevalent among livestock in several States east of the Mississippi River, and several European countries had refused to admit livestock from the United States except for immediate slaughter. Under congressional authority quarantine regulations were imposed and disease-control methods investigated. These measures finally gained the removal of the European restrictions.

THE PURPOSE OF REGULATORY WORK

As in the case of the animal quarantines, all the regulatory work of the Department is designed to eliminate or prevent social hazards, waste of resources, and economic abuses. Ethical, sanitary, conservation, or economic reasons underlie all the regulatory statutes which the Department administers. Thus the Food and Drugs Act and the Meat Inspection Act exist to insure to the public unadulterated foods and drugs and wholesome meats. The plant and animal quarantines are designed to prevent the introduction into this country, or the spread within it, of diseases and pests. The Migratory Bird Treaty Act is administered to protect game birds and insectivorous birds.

Such laws, however, have a wider purpose than merely to protect the public against economic loss or harmful goods. This wider purpose includes the promotion of agriculture and social welfare by a raising of technical and commercial standards. Regulatory action that assures the public of high-quality goods benefits producer and consumer alike. It protects the reputable producer against fraudulent or unscrupulous competition and safeguards both the pocket and the health of the consumer.

In general the regulatory laws administered by the Department affect the agricultural industry or industries utilizing agricultural products. That is the principal reason why the Department has been chosen to enforce them.

GRAIN AND COTTON ACTS

The Grain Standards Act and the Cotton Standards Act are good examples of regulatory laws that result in benefits far exceeding the prevention of abuses. These statutes do, of course, contain penal clauses for the prevention of improper trade practices. Probably more important, however, is their provision for fixed commodity standards, which encourage the production of improved commodities, and facilitate trade. The penal provisions of the Grain Standards Act have no other purpose than to promote a uniform method of grading in the general interest. Prior to its passage there was a total lack of uniformity in grain standards throughout the country. Commercial grades were established either by commercial boards of trade or chambers of commerce, except in half a dozen States that had enacted laws providing for grades and grain inspection. Grade terms meant different things in different places. Buyers could have little confidence in grade certificates. When Federal standards were promulgated under the Grain Standards Act, an immense improvement was brought about in grain-trading facilities. Similar advantages followed the enactment of the Cotton Standards Act. Buyers and sellers found themselves speaking a common trade language

and doing business more efficiently. Similarly, improved economic conditions resulted from the Federal Warehouse Act, which provides for the storage of crops in a manner that increases their value as loan collateral.

EXCLUSION OF PESTS

Perhaps the most convincing proof that regulatory laws are necessary is the entry of foreign plant pests. Until 1912 practically no control was exercised over their entry, and a stream of new enemies dangereous to our agricultural industry poured across our borders. Six new major pests got into the country in the 4 years immediately preceding 1912, when the Plant Quarantine Act was passed. These were the oriental fruit worm, the Japanese beetle, the citrus canker, the potato wart, the camphor scale, and the European corn borer. Other pests that had previously entered included the Hessian fly, the cotton bollweevil, the alfalfa weevil, the browntail and gipsy moths, the chestnut blight, the white pine blister rust, and the wheat smut. In 1929 the Mediterranean fruit fly, perhaps the worst fruit pest known, was found to have invaded Florida. In fact, 50 percent or more of our existing plant pests and diseases are of foreign origin. Foreign-plant quarantines have been successful in completely excluding serious insect pests and plant diseases, the Mediterranean fruit fly being the only pest of first importance known to have reached this country from other continents since the passage of the Plant Quarantine Act.

It should be pointed out that in 1900 Congress regulated the importation of wild animals and birds and prohibited the entry of such species as were injurious to agriculture. At that time only two birds, the English sparrow and the European starling, both injurious species, had become established in the United States. Since the enactment of this law, so far as known, no injurious species of mammal or bird has gained a foothold in this country.

EDUCATION TO SECURE LAW OBSERVANCE

Though most of the regulatory laws administered by the Department contain clauses providing for the punishment of the offenders, the Department's enforcement policy emphasizes service rather than punishment. Observance of the law is sought first by educational means, in a manner that emphasizes the common interest of producers and consumers in their impartial and effective application. Willful violations are rare, except in the case of game laws. For the most part the regulatory laws are administered with the hearty and intelligent cooperation of the commercial interests concerned. For example, the Food and Drugs Act authorizes litigation against manufacturers and sellers of food and drug products who do not comply with the statute. In many cases, however, the purpose of the law is fulfilled, not by a mechanical enforcement of its provisions, but by an educational and helpful policy which assists manufacturers and others to comply with its requirements.

In general, the Department strives to enlist the cooperation of the commercial agencies concerned, so that voluntary action may be substituted for the compulsory correction of improper practices. Many violations of the Food and Drugs Act result from lack of information about its requirements. An advisory rather than a puni-

tive policy has been adopted to lessen the number of such violations. The result has abundantly justified this course.

Some of the regulatory laws give the Department administrative discretion. Thus the Packers and Stockyards Act imposes upon the Secretary of Agriculture quasi-judicial duties. It authorizes him to issue "cease and desist" orders and to make findings in rate matters. On the other hand, the Caustic Poison Act gives no discretionary leeway. In all cases, however, the underlying principle is the same; namely, social and economic improvement. Adoption of an advisory rather than a bureaucratic attitude does not involve the Department in any relaxation of standards or requirements. It absolves no one from his responsibilities, but merely facilitates compliance with the law at considerable less expense.

EDUCATIONAL FUNCTIONS

Results of the research and other work done in the Department must be communicated to the public, or their value is largely lost. Research must have a mouthpiece. It cannot be done well in closed compartments without facilities for communicating results to scientific workers everywhere and to farmers and the general public. Work done in the dark means duplication of effort and loss of the stimulus that discovery in one field should have on other investigations in other fields. Hence, the Department maintains various informational services, which include a cooperative extension service, bulletins, motion pictures and exhibits, press and radio services, weather forecasts, crop and market reports, and outlook reports, periodicals, soil surveys, and correspondence with individuals.

Through the Extension Service, results of research done in the Department are correlated with research data obtained by the State experiment stations or State agricultural colleges. The combined material is carried by extension workers direct to farm men and the Extension Service maintains a network of communications covering the entire country.

GAP BETWEEN SCIENCE AND PRACTICE

When the Smith-Lever Act of May 8, 1914, was passed, setting up a Nation-wide organization for better agricultural education, it was declared in Congress that the Department and the State colleges and experiment stations had agricultural knowledge 25 years in advance of average farm practice. Today the gap, though not closed, is narrower. Agricultural science is put into practice probably quicker and more generally in the United States than in any other country. This is unquestionably the result of efficient educational work. So satisfied was Congress with the results achieved under the Smith-Lever Act that in 1928 it passed the Capper-Ketcham Act increasing the Federal contribution for extension work by $980,000 in 1929, and by $1,480,000 in 1930 and annually thereafter.

Agricultural education in the United States started long before the passage of the Smith-Lever Act.[1] It was under way in the

[1] A History of Agricultural Education in the United States, 1785–1925, by Alfred C. True, may be purchased from the Superintendent of Documents, Washington, D.C., for $1 a copy.

endowed colleges and State colleges early in the nineteenth century. It was tremendously strengthened by the Land Grant Act of 1862, giving large tracts to the States for the endowment of agricultural colleges. Other Federal legislation appropriates money to each of the States annually for scientific research and for extension work. The United States Department of Agriculture supervises the administration of these funds, and thus exercises a far-reaching influence on agricultural education. Agriculture and home economics are now taught not only in grade schools and in high schools and colleges, but in vocational schools. In the colleges of agriculture special training is provided for persons who intend to become teachers, experimenters, county agents, or farmers.

Publications issued by the Department are an important educational force. The Department distributes free each year approximately 25,000,000 bulletins, circulars, periodicals, publication lists, and other publications. The Department has made and distributed some 470 motion pictures on subjects of interest mainly to farmers. It is now circulating about 265 of these pictures. Probably 10,000,000 persons annually see one or more of the Department's educational films. Exhibits are prepared for fairs and exhibitions. Much information gathered in the Department finds an outlet through the press, and radio broadcasting has become important in the educational scheme.

COOPERATION WITH STATE AGENCIES

Much of the Department's most important work is done in close cooperation with State agencies. Federal and State efforts in research and in educational extension are tied together under the laws making provision for these activities.

The acts making annual appropriations for the Department of Agriculture provide that the Secretary of Agriculture shall coordinate the research of the Department with that of the State agricultural experiment stations. The Department and the stations are now cooperating in approximately 1,100 research projects, and in a large number of less formal ways. About 15 percent of the research of the experiment stations is done cooperatively with Federal research workers. Thus two great systems of agricultural investigation, functioning in close harmony, make a concerted attack on problems involving diverse conditions and requiring approach from many angles. Credit is shared by the Department and the stations for some of the most important developments in agricultural science. Scientific progress is always a cooperative result in large measure. In this country the cooperative principle in research has been emphasized increasingly for many decades.

COOPERATION IN EXTENSION WORK

In agricultural extension all the Department's work is done in cooperation with the State colleges of agriculture. Both the Smith-Lever Act of May 8, 1914, and the Capper-Ketcham Act of May 22, 1928, the first establishing and the second strengthening the extension system, contemplate a close relationship between Federal and State agencies. In the fiscal year ended June 30, 1933, the total

funds available for cooperative extension work were approximately $23,952,000, a reduction of about $2,000,000 from the amount available in the previous year. The Federal Government contributed 42.5 percent of this sum and 26.5 percent came from State appropriations to the agricultural colleges and other State agencies. The remainder came from county appropriations for extension work and from contributions by local organizations and individuals.

Not merely its large interest as a contributor of extension funds but its recognition of the need for cooperation as an aid to economy in expenditure, give the Federal Government a strong motive for emphasizing the cooperative principle in educational extension. The Department's field staff of extension workers joins with State workers in applying general economic and scientific information to State and local conditions. In this way a better result is achieved than either the Federal or the State extension forces could achieve independently.

COOPERATION IN FOREST PROTECTION AND REFORESTATION

Under the terms of the Clarke-McNary law of June 7, 1924, the Department cooperates with the States in the protection of State and private forest land from fire and in the production and distribution of forest planting stock for the purpose of establishing windbreaks, shelter belts, and farm woodlands upon denuded or nonforested lands within cooperating States. This cooperation is based upon the generally recognized principle that the welfare of the forests is in some measure a public interest, and the burden of their protection should be shared by the owners and the public alike.

CONTRIBUTION OF NONAGRICULTURAL RESEARCH

Agricultural science is, of course, not an isolated subject, walled off from other branches of knowledge, but a part of science as a whole. Hence the Department's research and extension program is helped by work done in fields apparently remote from agriculture, as well as by the cooperative relationship that exists between the Department and the agricultural colleges and experiment stations. What agricultural science in general and the Department's scientific work in particular owe to nonagricultural investigations cannot be measured.

Many examples of the cooperative nature of scientific progress could be cited. Specific discoveries depend for their full effect on varied applications, often in widely separated fields. Agriculture owes much to Federal support extended through the Department of Agriculture; it owes much to Federal and State aid given through State institutions. It is indebted also to scientific work wherever it is done, and whatever its character. Naturally it draws freely on the constantly increasing fund of scientific knowledge throughout the world.

THE DEPARTMENT'S FINANCES

In 1836, when the Commissioner of Patents began distributing a few seeds and plants, he did so without any specific Government authority or aid, except the use of the franks of the Congressmen.

Congress 3 years later appropriated $1,000 for the work. In 1849, when the Department of the Interior was established and the Patent Office merged therewith, the appropriation for agricultural work was $3,500. Modest appropriations for agriculture were continued until the creation of the Department of Agriculture in 1862. The total appropriation for the new Department during its first year was $64,000.

By 1889, the year in which the Department of Agriculture was made an executive branch of the Government, the annual appropriations had increased to nearly $2,000,000. Up to that time a large part of the appropriations had been used for the purchase and distribution of seeds and plants. After the creation of the Bureau of Animal Industry in 1884, funds became available for the control or suppression of livestock diseases, and, after the passage of the Hatch Act in 1887, for Federal support to State agricultural experiment stations for research. Comparatively small amounts were appropriated for the investigation of crop production, plant diseases, insect pests, forestry, highways, irrigation, reclamation, ornithology, cattle breeding, and related subjects.

From 1890 to 1900 the appropriations were gradually increased by Congress and reached a total of more than $4,000,000 in the latter year. The Weather Bureau was established as a part of the Department by transfer from the War Department in 1891, and the appropriation for the weather services exceeded $1,000,000 in 1900. For the same year the Bureau of Animal Industry received nearly $1,000,000. Federal payments to State experiment stations under the Hatch Act accounted for $720,000 of the total appropriation. Of the balance, the larger items were for the collection of agricultural statistics and for the distribution of seeds and plants.

For the fiscal year 1906 the Department's appropriations were more than $8,000,000. In 1907 a total in excess of $11,000,000 was provided, of which $3,000,000 constituted the first annual appropriation for the enforcement of the Federal Meat Inspection Act. By this time various regulatory and service activities had become important factors in the appropriations of the Department, notably the administration of the national-forest reserves, which had been transferred in 1905 from the Department of the Interior to the Department of Agriculture.

By 1913 the Department's appropriations had grown, by gradual annual increases, to $23,000,000. The fiscal year 1913 saw the establishment of the Office of Markets and Rural Organization, additional regulatory duties were imposed upon the Department by the passage of the Insecticide Act of 1910 and the Plant Quarantine Act of 1912, the research activities of the Department, particularly those of the Bureaus of Plant Industry and Entomology, had meanwhile been considerably expanded, and the work incident to the administration, protection, and development of the national forests further enlarged.

APPROPRIATIONS, 1913–34

Table 1 depicts the Department's appropriations over a 22-year period covering the fiscal years 1913 to 1934, inclusive, arranged by main groups of activities.

TABLE 1.—*Department of Agriculture appropriations, fiscal years 1913 to 1934, inclusive (as of Feb. 1, 1934)*

Fiscal year	Department general budget (exclusive of road emergency items)				Road and emergency items						Grand total
					Road construction						
	Ordinary activities	Forestry receipts and special funds	Payments to States for agricultural experiment stations, extension work, and cooperative forestry activities, including fire prevention	Total	Federal-aid roads	Forest roads and trails	Total	Emergency relief loans and collection expenses	Emergency items other than roads and relief loans	Total	
1913	$20,734,371	$869,085	$1,440,000	$23,043,456	$500,000		$500,000			$500,000	$23,543,456
1914	22,661,292	940,489	1,440,000	25,041,781							25,041,781
1915	26,993,345	973,641	1,920,000	29,886,986							29,886,986
1916	25,515,694	1,039,175	2,520,000	29,074,869							29,074,869
1917	27,142,516	1,202,990	3,020,000	31,365,506	5,000,000	$1,000,000	6,000,000			6,000,000	37,365,506
1918	[1] 57,370,039	1,482,245	3,520,000	62,372,284	10,000,000	1,000,000	11,000,000			11,000,000	73,372,284
1919	[2] 43,494,655	1,864,950	4,020,000	49,379,605	65,000,000	4,000,000	69,000,000			69,000,000	118,379,605
1920	40,568,285	3,470,000	6,120,000	50,158,285	95,000,000	4,000,000	99,000,000			99,000,000	149,158,285
1921	37,095,989	3,675,000	6,770,000	47,540,989	100,000,000	4,000,000	104,000,000			104,000,000	151,540,989
1922	[3] 40,101,825	3,670,000	7,420,000	51,191,825	75,000,000	6,000,000	81,000,000	$3,500,262		84,500,262	135,692,087
1923	41,217,016	3,670,000	7,720,000	52,607,016	25,000,000	11,000,000	36,000,000			36,000,000	88,607,016
1924	[4] 43,190,103	3,640,000	7,720,000	54,550,103	29,300,000	4,000,000	33,300,000	1,033,000		34,333,000	88,883,103
1925	[5] 48,165,741	3,780,750	7,720,380	59,666,871	13,000,000	7,000,000	20,000,000	19,315		20,019,315	79,686,186
1926	45,271,253	3,760,750	8,990,000	58,022,003	98,900,000	8,775,000	107,675,000	24,000		107,699,000	165,721,003
1927	[6] 58,459,573	3,771,250	9,545,000	71,775,823	75,000,000	6,400,000	81,400,000	15,000		81,415,000	153,190,823
1928	[7] 55,289,299	3,771,250	10,315,000	69,375,549	71,000,000	8,380,000	79,380,000	10,000		79,390,000	148,765,549
1929	[8] 60,810,816	3,430,500	12,265,282	76,506,598	[9] 82,351,294	7,500,000	89,851,294	6,015,000		95,866,294	172,372,892
1930	[10] 63,144,054	3,445,500	13,480,936	80,070,490	[11] 107,060,000	10,000,000	117,060,000	6,010,000		123,070,000	203,140,490
1931	[12] 67,343,101	4,015,500	14,805,936	86,164,537	[13] 198,091,935	[14] 14,000,000	212,091,935	45,090,318	[15] $4,699,300	261,881,553	348,046,090
1932	[16] 73,042,821	4,015,500	14,899,936	91,958,257	175,000,000	12,500,000	187,500,000	[17] 22,125,000		209,625,000	301,583,257
1933	59,666,083	3,555,475	14,793,636	78,015,194	[18] 222,000,000	[19] 13,905,000	235,905,000	(17)	[20] 5,000,000	240,905,000	318,920,194
1934	[21] 53,671,448	3,087,020	14,781,339	71,539,807	[22] 447,431,000	[23] 19,457,400	466,888,400		[24] 156,544,504	623,432,904	694,972,711

[1] Includes $25,346,000 war-emergency funds.
[2] Includes $12,120,863 war-emergency funds.
[3] Includes $143,811 for increase of compensation, properly chargeable to road funds.
[4] Includes $2,500,000 for eradication of foot-and-mouth disease.
[5] Includes $3,500,000 for eradication of foot-and-mouth disease.
[6] Includes $10,000,000 for control of European corn borer.

[7] Includes $5,000,000 for compensation of farmers for nonproduction of cotton in pink-bollworm infested areas.
[8] Includes $4,250,000 for eradication of Mediterranean fruit fly.
[9] Includes $8,851,294 for restoration of flood-damaged roads and bridges and $2,500,000 for Mount Vernon Memorial Highway.
[10] Includes $1,290,000 for eradication of Mediterranean fruit fly.
[11] Includes $1,660,000 for restoration of flood-damaged roads and bridges.
[12] Includes $1,740,000 for eradication of Mediterranean fruit fly.
[13] Includes $83,000,000 for emergency construction of Federal-aid roads (including $3,000,000 for public-land highways), $1,391,935 for flood-damaged roads and bridges, and $4,700, 000 for Mount Vernon Memorial Highway.
[14] Includes $3,000,000 for emergency construction of national-forest highways.
[15] Includes $3,000,000 for emergency construction work on national forests and $1,699,300 for miscellaneous construction and employment projects.
[16] Includes $179,940 for general-expense appropriations of Bureau of Public Roads; no comparable figures for 1933 and 1934. (In table 2 this figure is omitted.)
[17] Additional crop-production loans during fiscal years 1932 and 1933 from funds of Reconstruction Finance Corporation. (All seed and crop-production loan work transferred, by Executive order, to Farm Credit Administration on May 27, 1933.)
[18] Includes $122,000,000 for emergency construction of Federal-aid roads (including $2,000,000 for public-land highways).
[19] Includes $5,000,000 for emergency construction of national-forest highways.
[20] Emergency construction work on national forests.
[21] Reduced to $42,714,022 under limitation established on cash withdrawals from the Treasury as a part of the economy program of the Government. (See table 2.)
[22] Includes $400,000,000 for emergency construction of Federal-aid highways, also (as of Nov. 1, 1933) allotments of $5,000,000 for public-land highways and $7,431,000 for special road grants to certain States, authorized by National Industrial Recovery Act of June 16, 1933; and $35,000,000 for Federal-aid highways provided by Agricultural Appropriation Act, 1934.
[23] Includes allotment of $15,000,000 (as of Feb. 1, 1934) for emergency construction of national-forest highways, authorized by National Industrial Recovery Act; also $4,457,400 provided by Agricultural Appropriation Act, 1934.
[24] Includes $100,000,000 direct appropriation for administration of the Agricultural Adjustment Act (but exclusive of an indefinite amount accruing from taxes imposed under this act on processors of agricultural commodities); also (as of Feb. 1, 1934) allotments to Department of Agriculture, from appropriations authorized by National Industrial Recovery Act, of $10,000,000 for emergency construction work on national forests (including roads, trails, bridges, and other improvements), $20,641,884 for construction, repair, and improvement projects at Department field stations, as well as in the District of Columbia, $5,480,620 for the control of certain plant diseases and insect pests, and $20,000,000 for the purchase of forest lands as authorized by the Emergency Conservation Act of Mar. 31, 1933.

EXPLANATION OF TABLE 1

Ordinary activities.—When the United States entered the World War in 1917, Congress provided special emergency appropriations for stimulating agriculture and facilitating the distribution of agricultural products. War-emergency appropriations for the fiscal year 1918 exceeded $25,000,000 and for the fiscal year 1919 were over $12,000,000. These funds are included in table 1 under the column "ordinary activities", which shows a total of $57,000,000 for the fiscal year 1918 and $43,000,000 for 1919. In the post-war adjustment period the appropriations for the ordinary activities of the Department were for several years maintained at around the 1919 level. In 1924 and 1925, $2,500,000 and $3,500,000, respectively, were provided for the eradication of the dangerous foot-and-mouth disease of cattle; in 1927 a special appropriation of $10,000,000 was made for the control of the European corn borer; and in 1928, $5,000,000 was provided for compensating cotton farmers who agreed to allow their fields to remain idle as a measure for the control of the pink bollworm of cotton. Appropriations of $4,250,000 in 1929, $1,290,000 in 1930, and $1,740,000 in 1931 were made to finance the Department's intensive campaign against the Mediterranean fruit fly in Florida and adjacent States. The amount for ordinary activities in 1932 was $73,000,000, or an increase of $6,000,000 over the total for 1931, consisting of $2,000,000 for strengthening the research work of the Department as a whole and about $4,000,000 for service and regulatory activities, including such items as meteorological work to assist commercial aviation, tuberculosis eradication, national-forest improvements, acquisition of lands for bird refuges, enforcement of the Perishable Agricultural Commodities Act, market inspection and news services, and enforcement of the Food and Drugs Act. In the fiscal years 1933 and 1934 the Department's funds for ordinary activities were drastically reduced in pursuance of the retrenchment program made necessary for the Federal service as a whole to keep expenditures for general purposes within the Government's diminished receipts, due to the wide-spread economic depression.

Forestry receipts and special funds.—These funds consist almost entirely of national forest receipts and sums contributed by private cooperators. The amount from year to year is governed entirely by the volume of business transacted on the national forests. The major part of these forest-receipts moneys is paid to the States in which the national forests are located, to be used for the benefit of county roads and schools.

Payments to States.—Under this head are included Federal appropriations authorized by the Hatch Act of 1887, Adams Act of 1906, and Purnell Act of 1925, for direct payment to State agricultural experiment stations for research work; payments to State colleges of agriculture for extension work under the Smith-Lever Act of 1914, Capper-Ketcham Act of 1928, and supplemental acts; and amounts paid to the States under the Weeks forestry law of 1911 and the Clarke-McNary Reforestation Act of 1924 for the cooperative prevention of fires on State and privately owned timberlands and for the cooperative distribution of forest planting stock.

Road construction.—In the fiscal year 1913 a special appropriation of $500,000 was made for the building of post roads in cooperation with the States or their local units. A definite program of cooperation with the several States in road construction was instituted beginning with the fiscal year 1917 under the Federal Aid Road Act of July 11, 1916, which was amended by the Federal Highway Act of November 9, 1921. The amounts shown in table 1 for the fiscal years 1917 to 1928, inclusive, were on the basis of the authorizations contained in these two acts and supplemental acts. The Federal-aid road figures for 1929, 1930, and 1931 include, in addition, special appropriations for the restoration of flood-damaged roads and bridges and for the construction of the Mount Vernon Memorial Highway; and the Federal-aid and forest-road appropriations for 1931, 1933, and 1934, contain emergency funds provided especially for the relief of unemployment.

GENERAL APPROPRIATIONS, FISCAL YEARS 1932, 1933, AND 1934

Table 2 shows, by bureaus, the appropriations provided by Congress for the Department's regular, continuing activities, as contrasted with road and emergency items, during each of the fiscal years 1932, 1933, and 1934. In furtherance of the economy program of the Government an expenditure limitation was established on cash withdrawals for these general activities in 1934, as shown by the table.

TABLE 2.—*Appropriations of Department of Agriculture for general purposes, fiscal years 1932, 1933, and 1934*

[Exclusive of road funds, public works, agricultural adjustment, and other emergency funds]

Bureau and item	Appropriation, 1932	Appropriation, 1933	Appropriation. 1934	Expenditure limitation, 1934
(1) Ordinary activities:				
Office of the Secretary	$1,322,115	$1,206,547	$1,164,561	$1,039,442
Office of Information	1,420,961	1,335,800	1,226,287	916,966
Library	110,620	106,100	100,223	87,551
Office of Experiment Stations	399,410	294,294	226,961	198,670
Extension Service	1,793,560	1,688,170	1,583,822	1,189,267
Weather Bureau	4,497,720	4,164,038	3,731,235	2,905,884
Bureau of Animal Industry	16,085,195	15,324,947	14,398,524	11,778,135
Bureau of Dairy Industry	796,990	717,448	655,130	540,000
Bureau of Plant Industry	5,839,238	4,930,874	4,496,155	3,607,833
Forest Service	15,184,620	10,780,924	9,952,610	7,651,559
Bureau of Chemistry and Soils	2,104,051	1,925,080	1,766,458	1,470,305
Bureau of Entomology	2,863,740	2,471,700	2,213,968	1,704,241
Bureau of Biological Survey	2,229,170	1,756,177	1,356,280	1,017,261
Bureau of Agricultural Engineering	656,990	618,690	508,206	422,491
Bureau of Agricultural Economics	7,272,163	6,686,799	6,130,260	4,768,191
Bureau of Home Economics	246,700	233,365	212,749	169,338
Bureau of Plant Quarantine	3,747,930	2,490,125	2,158,514	1,580,749
Grain Futures Administration	221,480	218,838	200,000	173,139
Food and Drug Administration	1,810,228	1,716,167	1,589,505	1,493,000
Total, ordinary activities, exclusive of forest-fire deficiency	[1] 68,602,881	58,666,083	53,671,448	42,714,022
Forest-fire deficiency	4,260,000	1,000,000	[2]	[2]
Total, ordinary activites, as above	[1] 72,862,881	59,666,083	53,671,448	42,714,022

[1] Exclusive of $179,940 for general-expenses appropriations of Bureau of Public Roads, fiscal year 1932, for which there are no comparable items in 1933 and 1934.
[2] Not yet appropriated.

TABLE 2.—*Appropriations of Department of Agriculture for general purposes, fiscal years 1932, 1933, and 1934*—Continued

[Exclusive of road funds, public works, agricultural adjustment, and other emergency funds]

Bureau and item	Appropriation, 1932	Appropriation, 1933	Appropriation, 1934	Expenditure limitation, 1934
(2) Forestry receipts and special funds	$4,015,500	$3,555,475	$3,087,020	$2,630,020
Total, Department general budget, exclusive of payments to States	[1] 76,878,381	63,221,558	56,758,468	45,344,042
(3) Payments to States (exclusive of national-forest receipt funds):				
Agricultural experiment stations	4,357,000	4,374,000	4,381,000	4,381,000
Extension work	8,672,936	8,728,096	8,738,096	8,738,096
Cooperative forest-fire prevention	1,775,000	1,611,580	1,587,513	1,190,635
Cooperative distribution of forest planting stock	95,000	79,960	74,730	56,047
Total, payments to States, as above	14,899,936	14,793,636	14,781,339	14,365,778
Grand total	[1] 91,778,317	78,015,194	[3] 71,539,807	[3] 59,709,820

[1] Exclusive of $179,940 for general-expenses appropriations of Bureau of Public Roads, fiscal year 1932, for which there are no comparable items in 1933 and 1934.
[3] As of Feb. 1, 1934.

EMERGENCY AND RELIEF FUNDS, 1934

Emergency funds available for expenditure by the Department during the fiscal year 1934 include a direct appropriation of $100,000,000 for the administration of the Agricultural Adjustment Act, together with the receipts derived from taxes imposed under this act on processors of agricultural commodities; and approximately $484,000,000 allotted to the Department of Agriculture up to February 1, 1934, from appropriations authorized by sections 202, 204, and 205 of the National Industrial Recovery Act of June 16, 1933, including $400,000,000 for Federal-aid highways, $15,000,000 for national-forest highways, $5,000,00 for roads through public lands other than forest reserves, $7,000,000 for special road grants to certain States, $10,000,000 for emergency construction on national forests (including roads, trails, bridges, and other improvements), $27,000,000 for a large number of construction, repair, and improvement projects at the Department's field stations, as well as in the District of Columbia, and for the control of certain plant diseases and insect pests, and $20,000,000 for the purchase of forest lands as authorized by the Emergency Conservation Act of March 31, 1933.

EXPENDITURES FOR THE FISCAL YEAR 1933

Expenditures, rather than appropriations, give the best index to the cost of the Department's work. Certain appropriations carry over from one year to another. Hence, in some years the appropriations for a given item may be relatively small, while the actual expenditures, frequently involving funds carried over from a previous year, may be relatively large. Tables 3 and 4 show the amounts expended and obligated by the Department for the fiscal year ended June 30, 1933, classified by organization units and by types of activity.

TABLE 3.—*Expenditures and obligations, fiscal year 1933, classified by organization units*

Organization unit	Ordinary activities	Forestry receipts and special funds	Payments to States [1]	Total
General:				
Office of the Secretary	$1,001,945			$1,001,945
Office of Information	1,013,681			1,013,681
Library	98,351			98,351
Office of Experiment Stations	218,612		$4,359,000	4,577,612
Extension Service	1,509,335		8,652,815	10,162,150
Weather Bureau	3,524,589			3,524,589
Bureau of Animal Industry	12,676,564			12,676,564
Bureau of Dairy Industry	602,288			602,288
Bureau of Plant Industry	4,461,379			4,461,379
Forest Service	10,942,003	$2,988,124	1,601,831	15,531,958
Bureau of Chemistry and Soils	1,643,331			1,643,331
Bureau of Entomology	2,109,500			2,109,500
Bureau of Biological Survey	1,673,800			1,673,800
Bureau of Public Roads	564,760			564,760
Bureau of Agricultural Engineering	551,565			551,565
Bureau of Agricultural Economics	5,844,167			5,844,167
Bureau of Home Economics	189,498			189,498
Bureau of Plant Quarantine	2,205,033			2,205,033
Grain Futures Administration	167,510			167,510
Food and Drug Administration	1,534,975			1,534,975
Total, general items	52,532,886	2,988,124	14,613,646	70,134,656
Emergency (including road funds):				
Road construction				177,977,564
Emergency construction on national forests				4,193,292
Farmers' Seed Loan Office				539,203
Agricultural Adjustment Administration				16,681
Total, emergency items (including road funds)				182,726,740
Grand total				252,861,396

[1] Exclusive of Federal-aid road and national-forest receipt funds.

TABLE 4.—*Expenditures and obligations, fiscal year 1933, classified by types of activity*

Type of activity	Ordinary activities		Forestry receipts and special funds	Payments to States [1]	Total	
	Amount	Per-cent			Amount	Per-cent
General:						
Research	[2] $14,435,697	27.5	$3,316	$4,359,000	$18,798,013	7.4
Extension	2,139,182	4.1		8,652,815	10,791,997	4.3
Eradication or control of crop and animal pests	9,065,157	17.3			9,065,157	3.6
Regulatory work	10,524,741	20.0			10,524,741	4.2
Public-service activities	16,368,109	31.1	2,984,808	1,601,831	20,954,748	8.2
Total, general	52,532,886	100.0	2,988,124	14,613,646	70,134,656	27.7
Percentage of total for general items	74.9		4.3	20.8	100.0	
Percentage of grand total	20.8		1.2	5.7	27.7	
Emergency (including road funds):						
Road construction					$177,977,564	70.4
Emergency construction on national forests					4,193,292	1.7
Emergency relief loans and collections					539,203	.2
Agricultural Adjustment Administration					16,681	
Total, emergency (including road funds)					182,726,740	72.3
Grand total					252,861,396	100.0

[1] Exclusive of Federal-aid road and national-forest receipt funds.
[2] Expenditures for research work by the Department itself (not including payments to States) are 5.7 percent of the grand total for all purposes.

FUNDS FOR RESEARCH

During recent years there has been increasing interest and financial support for the research work of the Department, although for the fiscal years 1933 and 1934, due to the need for retrenchment in Government expenditures, the funds for this purpose were materially reduced below the total for the previous years. Table 5 shows the estimated expenditures for research work for the fiscal years 1923 to 1934, inclusive:

TABLE 5.—*Expenditures for research*

Fiscal year	By Department [1]	Payments to State experiment stations	Total	Fiscal year	By Department [1]	Payments to State experiment stations	Total
1923	$9,000,000	$1,440,000	$10,440,000	1929	$13,969,275	$3,840,000	$17,809,275
1924	9,693,351	1,440,000	11,133,351	1930	15,730,363	4,335,000	20,065,363
1925	10,139,232	1,440,000	11,579,232	1931	17,472,529	4,340,000	21,812,529
1926	10,420,970	2,400,000	12,820,970	1932	18,206,863	4,357,000	22,563,863
1927	10,984,007	2,880,000	13,864,007	1933	14,805,081	4,359,000	19,164,081
1928	12,147,672	3,360,000	15,507,672	1934 [2]	12,000,000	4,381,000	16,381,000

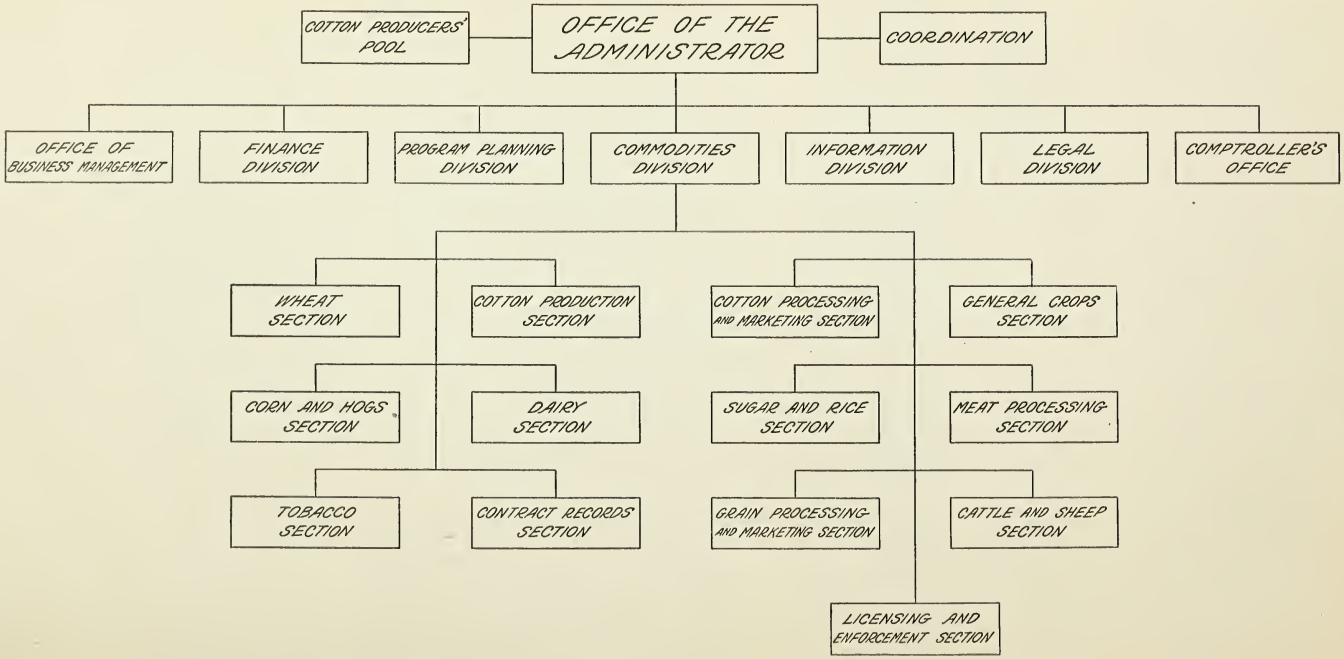
[1] Includes pro rata of general Department administrative and overhead expenses, publication, legal and library work.
[2] Estimate.

RELATION TO TOTAL FEDERAL OUTLAY

The expenditures of the Government as a whole for the fiscal year which ended June 30, 1933, were approximately $5,300,000. The entire expenditure of the Department of Agriculture, including $70,000,000 for general items, nearly $178,000,000 for roads, and some $5,000,000 for various emergency objects, was, in round numbers, $253,000,000 or 4.8 percent of the total expenditure of the Government. The total of $70,000,000 expended under the general budget of the Department was about 1.5 percent of the total for the Government as a whole. This $70,000,000, however, includes approximately $15,000,000 in direct payments to the States for agricultural experiment stations, extension work, and certain forestry activities, leaving $55,000,000 for the ordinary activities of the Department and projects financed from national-forest receipts and other special forestry funds. The latter figure is about 1 percent of the expenditure charged in 1933 to the entire Federal service.

Among the larger items of expenditure for the fiscal year 1933, exclusive of those for road construction, payments to States, and for emergency projects, were $4,600,000 to combat bovine tuberculosis, $4,800,000 for meat inspection, $1,500,000 for the enforcement of food and drug laws, $3,500,000 for the weather service, $1,200,000 for the market news service, and $15,500,000 for the administration, protection, and development of the national forests.

AGRICULTURAL ADJUSTMENT ADMINISTRATION



THE ORGANIZATION UNITS

AGRICULTURAL ADJUSTMENT ADMINISTRATION

In May 1933 Congress passed, and the President approved the Agricultural Adjustment Act, properly titled "An act to relieve the existing national economic emergency by increasing agricultural purchasing power." It contains three distinct parts.

One part empowers the President, through the Secretary of Agriculture, to take measures to increase agricultural purchasing power by raising farm income; another empowers the Farm Credit Administration to take measures to lighten the load of farm mortgages; the third grants to the President certain powers in regard to the national currency and credit.

Only one of these parts, the first, is under the jurisdiction of the Department of Agriculture. The farm-mortgage section of the act is administered by the Farm Credit Administration, created on May 12 by Executive order of the President. The currency and credit powers in the third portion of the act are granted to the President himself.

The act declares that it is the policy of Congress to raise the purchasing power of American farmers to the level which it occupied in the "base period", the 5 years 1909 to 1914, when agricultural and industrial production and prices were well balanced and the national income was equitably distributed.

This policy of increasing agricultural purchasing power is necessary because of the sharp and inequitable decline of that purchasing power since the World War and more especially during the 4 years beginning with 1929, when farm incomes decreased more rapidly and to a greater degree than did the incomes of other industries.

Broad and flexible powers, and a wide variety of means and methods, are provided for effectuating the purposes of the act.

Flexibility and variety in these methods are necessary because agriculture is a complex industry with wide differences among the problems of different commodities and of different regions. It is essential that the Agricultural Adjustment Administration be able to change strategy and tactics of the attack as the problems themselves differ and as the general situation changes.

TWO KINDS OF POWERS

Roughly, the powers under the Adjustment Act fall into two groups.

One group enables the Agricultural Adjustment Administration to take measures to balance production of farm goods with the effective demand for them, and thus to bring about increased farm income and farm purchasing power with a sound economic base resting upon the laws of supply and demand.

Authority granted for this purpose recognizes the existence of overproduction and of an oversupply—an actual physical surplus—of many farm products; it recognizes the necessity of reducing this oversupply and refraining from further overproduction if the farmer is to receive his fair share of the national income. This group of powers enables the United States Government to assist farmers in making an adjustment in their production which it is impossible for them to make unaided and acting as individuals.

The act authorizes the use of several methods, separately or in combination, to make this adjustment. It provides a method of giving financial assistance to farmers who, voluntarily and not otherwise, cooperate with the Government in making the necessary adjustment. It provides no means or authority for direct financial aid to farmers who do not cooperate in the adjustment. Therefore, it offers an incentive for cooperation and none for not cooperating.

This feature of the act is exemplified in programs for adjusting the production of wheat, cotton, tobacco, corn, and hogs, and in plans contemplated for other commodities. Growers who cooperate in the program of the Agricultural Adjustment Administration for those commodities specified receive compensatory payments—rental payments and opportunities to purchase cotton options at less than the market price, in the case of cotton; direct payments based upon adjustments in volume of production for market in the case of wheat and tobacco. Producers who do not cooperate in the necessary adjustments are not entitled to receive such payments.

The Adjustment Act provides for no compulsion of producers. They are wholly at liberty to produce any commodity in any volume they choose, but if they do not join in the program of adjustment to a sounder economic basis, they must meet economic and marketing problems without direct governmental assistance. It is expected all farmers will be indirect beneficiaries of successful adjustments.

The second group of powers contained in the act is also directed toward giving the producer of agricultural commodities more nearly his fair share of the national income. These powers are conferred by the marketing-agreement section of the act and relate to prices to producers and to consumers and to trade practices among processors and distributors of farm products. They make the Government both an arbiter and a partner in agreements among associations of producers, processors, and distributors of farm goods.

Like the measures for adjusting production, these powers are aimed at assisting private industry, in this case processors and distributors as well as producers, to change its practices so as to benefit all interests engaged in getting farm products from the soil to the consumer in such a manner as to equal or approach parity prices to farmers and at the same time to protect the consumer from any unfair increase in his costs.

Just as farmers are unable to adjust their production without the aid of the centralizing power of the Government, distributors are unable, without that same assistance, to cooperate in avoiding certain wasteful and damaging distribution practices.

Both groups of powers conferred by the Agricultural Adjustment Act are directed toward economically balanced production of agricultural commodities on the one hand, looking toward a fair share of

the national income for farmers, and on the other hand a system of distributing farm products that will be economically sound.

In order to apply the powers and achieve the purposes of the Adjustment Act, the Secretary of Agriculture has set up within the Department of Agriculture a new organization, the Agricultural Adjustment Administration, devoted specifically to these duties. The Administration's activities are coordinated closely with those of the rest of the department. It draws upon the scientific knowledge, the accumulated statistical data, and the informational, organizing, and educational facilities of the other bureaus and offices within the Department.

The organization is headed by an administrator responsible for directing all of its activities. There are three assistant administrators, one of whom heads the Commodities Division, one the Division of Information, and one the Planning Division. Other parts of the organization include the Finance Division, the Office of the General Counsel, the Office of the Consumers' Counsel, and the Office of the Comptroller.

Within the Commodities Division are sections dealing with wheat production, grain processing and marketing, corn and hogs, meat processing and marketing, cotton production, cotton processing and marketing, dairy production, tobacco, rice and sugar, special crops, cattle and sheep, field investigation, and contract records. Each section is headed by a chief, with economic advisers and administrative assistants.

STEPS TAKEN IN 1933

On June 19, 1933, the Adjustment Administration announced a program of cooperation with cotton growers. It offered two plans: (1) A cash payment per acre to the individual farmer in return for an agreement to reduce his acreage; and (2) a cash payment per acre plus an option to buy at 6 cents a pound a quantity of Government-owned cotton equal to the farmer's reduction in output. Payments were to vary with yields per acre. Approximately 1,031,000 cotton producers contracted to withdraw 10,396,000 acres. On this area the production, if the crop had been allowed to mature, would have exceeded 4,300,000 bales. The reduction strengthened the cotton market, but was only the first step in cotton control. It is planned to limit the cotton area in 1934 to approximately 25,000,000 acres.

Wheat farmers, representing 80 percent of all the wheat acreage in the country, contracted to reduce their plantings by 8,000,000 acres in 1934. An international wheat agreement among the principal importing and exporting countries was signed at London on August 25, 1933. This country's wheat-restriction program harmonized with that agreement.

In an emergency hog-adjustment program the Administration purchased 6,200,000 pigs and 200,000 sows due to farrow. Announcement of a more permanent program, including corn, as well as hogs, followed. This program called on participating farmers for a reduction of 20 to 30 percent in their acreage of corn and of 25 percent in the number of hogs farrowed and marketed.

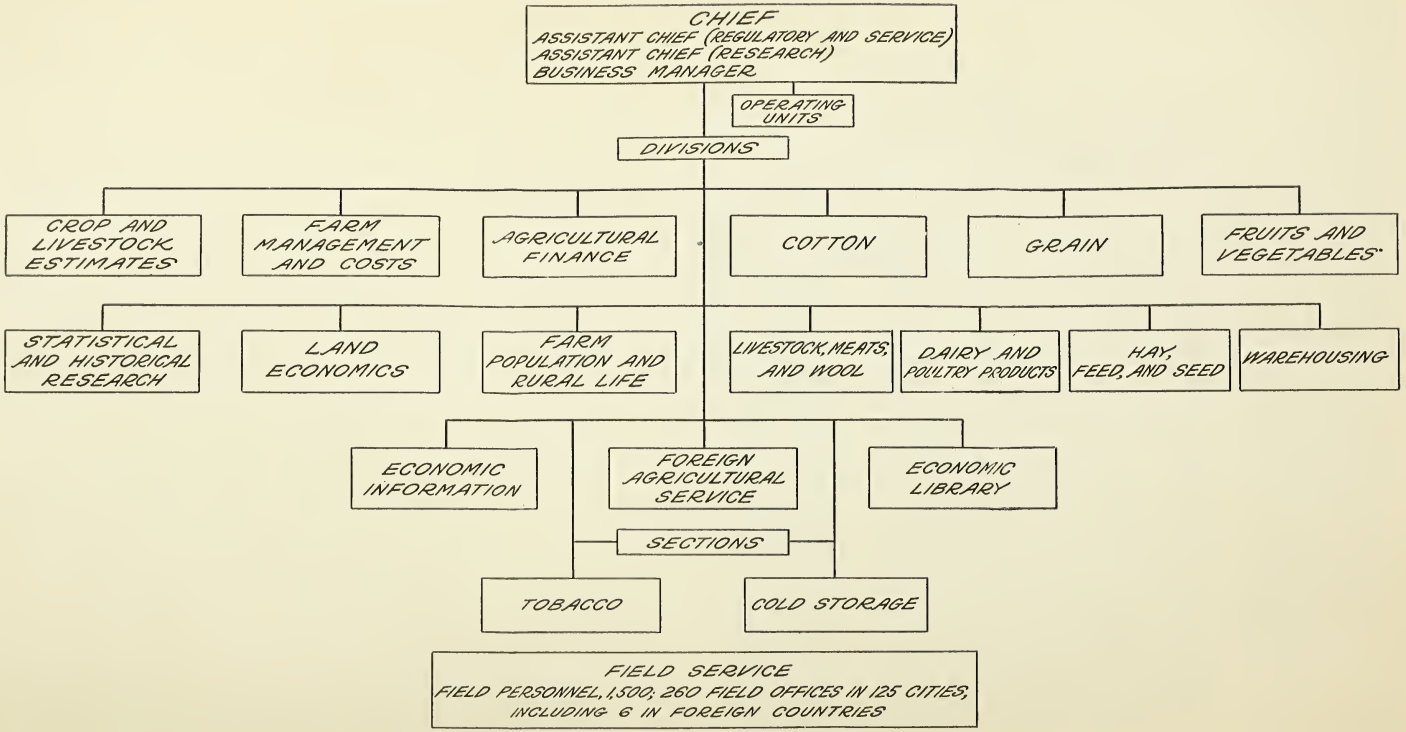
As compensation for cotton-, wheat-, and tobacco-acreage reductions, and in removing a burdensome supply of hogs from market,

the Administration made payments to farmers amounting to about $300,000,000. For corn and hog reduction, it expected to pay $350,000,000. Taxes were imposed on the first processing of the commodities involved to furnish necessary funds. These taxes, in the main, will be passed on to consumers, whose power to pay them will increase as business recovery proceeds. Increased farm earnings will be an important aid to that recovery.

The dairy program of the Agricultural Adjustment Administration includes two main lines of effort. They are, first, marketing agreements and licenses for city milk sheds containing only such provisions as can be promptly and vigorously enforced, particularly safeguarding uniform producers' prices set for each market at as high a point as can be sustained in the light of all economic factors affecting that market; and, second, the formulation of a general dairy program aimed to increase all dairy farmers' income, whether from sale of whole milk or manufactured products, by adjustment and regulation of production, induced through distribution of adjustment payments. The aim of the Administration is to make these two lines of effort supplementary to each other and to bring about a balanced relationship between the prices of manufactured dairy products and fluid milk.

Adjustment programs designed to bring production more nearly into line with consumption requirements were undertaken for each of the six kinds of tobacco which have been classified as basic agricultural commodities. These are cigar-leaf, flue-cured, burley, fire-cured, dark air-cured, and Maryland.

BUREAU OF AGRICULTURAL ECONOMICS



BUREAU OF AGRICULTURAL ECONOMICS

The Bureau of Agricultural Economics is concerned primarily with the economics of farm production and marketing, and with economic policies—land utilization, credit, taxation, etc.—that affect agriculture and farm living conditions. Success in agriculture depends not only on production but also on organization of the farm enterprise in such a manner that maximum net returns may be obtained, and on many other economic questions. The handling and distribution of farm products, as well as production itself, must be efficient. Hence, aside from the strictly technological problems of agricultural engineering and of crop and livestock production, the Bureau of Agricultural Economics deals with all the varied aspects of the problem of making agriculture profitable, and farm life a satisfactory mode of living.

The Bureau deals with agricultural problems largely from a broad, national viewpoint. Agriculture should be the source of ample supplies of food and raw materials available at prices that are reasonable to the consumer and yet adequate to provide the basis for satisfactory farm life. At the same time a proper balance should be maintained between agriculture and the other phases of our national life. The primary aim of the Bureau is to help bring about these conditions. To this end it concerns itself with the continual changes and shifts in economic conditions that affect agriculture, and studies how farmers may adjust their various activities so as to maintain satisfactory supply-and-demand relationships.

In short, the Bureau is a fact-finding and fact-interpreting institution. In production studies it deals with the relation of supply to market requirements, with the quality of products that the markets chiefly require, and with methods of increasing the efficiency of farm production. Maximum net profits in agriculture result only when there is a complete coordination of the physical with the economic phases of production. Accordingly, the Bureau emphasizes equally the technical economic problems of production on individual farms and the broader problems involved in adjusting production to demand and in advantageously handling and distributing farm products.

PRACTICAL NEEDS SHAPE POLICY

Sociological aspects of agriculture form another concern of the Bureau. Conditions of living on the farm and in the farm community are studied with a view to determining facts and indicating possibilities of improvement. To obtain more money for farm families or a larger comparative return, while in itself important, is only part of the problem. The other parts relate to the best use of these increased returns to bring a satisfactory life to the farm family and the farm community. There are many farming areas today in which the schools, churches, health facilities, and recreation facilities are so

deficient that increasing the income of the individual farmer would not, in itself, provide a satisfactory life for his family in the area in which the farm is located.

The practical, everyday needs of farmers and of agriculture in general are paramount in shaping the bureau's research and service activities, and in its administration of regulatory legislation. Agriculture probably is the world's most competitive industry, and the competition is not merely local and national but world-wide. Moreover, agriculture is subject to hazards of climate and pests over which the farmer has little control. It is, therefore, essential that farmers should be helped as far as possible to anticipate future conditions.

The collection of statistics of agricultural production and the estimating of acreages planted and prospective yields have been important activities of the Department since its inception. Knowledge of supplies available and supplies to come is necessary to the plans of both farmers and business men. Elaborate systems of checks and balances have been developed to insure unbiased reports. Practically every farm commodity is covered, and the findings are eagerly awaited and immediately used by the largest exchanges and business houses of the country, as well as by farmers and farm leaders throughout the Nation.

The estimates of crop production and numbers of livestock are not based on judgment figures or opinions, but on returns from more than 300,000 individual farmers, each farmer reporting for his own farm. These estimates are not enumerations. They are systematic attempts, based on samples or other evidence, to estimate the probable out-turn of the crops. The aim is to show the probable production as indicated by evidence available as of the date for which the report is issued. Subsequent changes in conditions are taken into account in later reports. The crop-reporting service is generally considered the most adequate and accurate reporting service of its kind in the world. It is furnishing to the grower, to the distributor, and to the consumer invaluable information to replace the wild guesses that were formerly issued from the most varied and often biased sources.

Facts and figures must be analyzed and interpreted if they are to aid producers in planning their production and marketing. Since 1923, the Bureau has issued an annual outlook report, a review of the prospective conditions of supply and demand affecting 40 or more important crops. This is supplemented by similar reports, more restricted in scope, issued throughout the year. Significant tendencies in farm production are analyzed, and an attempt is made to indicate the probable trend of supply and demand during the forthcoming year and even for a longer period. During the last 3 or 4 years the outlook reports have proved to be about 90 percent correct.

STANDARDIZATION AND INSPECTION

Commodity standardization and inspection are among the Bureau's principal functions, although the establishment and use of uniform standards of quality for farm products is a comparatively recent development. Little had been accomplished in a national way in

this field prior to 1913, but since that time much progress has been made. The development of national standards for farm products is essentially a process of evolution, for established trade practices yield slowly to the forces making for change and improvement. In large-scale marketing, however, such standardization is now universally recognized as a basic requirement. Whether or not the producer or the distributor is rewarded for the expense involved in making the necessary classification depends largely on his subsequent marketing practices. The standardization and inspection of farm products, when associated with a wise marketing policy in general, effect substantial savings.

The chief advantages of standardization are: (1) The establishment of a common language between buyers and sellers and other interested parties, and (2) actual separation of products into different grades of market quality. As a basis for trading, a common trade language is indispensable, particularly in the case of commodities like cotton and grain, which are handled very largely in futures contracts. In the case of many commodities not dealt with so extensively in futures, a large amount of business is still done on vague descriptions. This loose method gives rise to frequent disputes. One of the most conspicuous advantages of standardization is its power to prevent trade disputes. When differences arise unavoidably, standardization facilitates the settlement of claims.

Equally important advantages result from the separation of the product into different qualities. For instance, it enables cooperative marketing associations to pool the products of individual growers, so that lots of different qualities may be assembled in commercially significant quantities. By this means it becomes possible to reflect quality differences in the prices paid to growers. Another advantage is that trading on a quality basis is a great stimulus to better methods of production. In fact, high-quality production cannot be expected of the farmer unless he is paid according to quality. Where no standards are recognized, the tendency of the markets is to pay a flat price based on the average value of the commodities received, a practice that penalizes the producer of superior goods.

Standardization work in the Bureau of Agricultural Economics has two forms: (1) The formulation for mandatory use of standards required by law, and (2) the formulation and recommendation, after a study of trade requirements, of standards for optional use. Official standards for cotton, for example, are required under the United States Cotton Standards Act, and must be used in the marketing of cotton in interstate commerce. Under the terms of the United States Cotton Futures Act, all cotton tendered in the settlement of cotton-futures contracts must be classed and certified by the Bureau through its boards of cotton examiners at delivery points. In like manner, official standards are maintained, and their use is required by law in the merchandising of the principal grains in interstate commerce, when such merchandising is done on a basis of grades. Under the United States Grain Standards Act all grain sold or shipped or offered for sale or shipment in interstate commerce on the basis of grades must be inspected and certificated according to official standards. Initial inspections are made by licensed inspectors, and the Bureau maintains a force of skilled inspectors to supervise the

licensed inspectors and to handle appeals from their decisions. Thus, standardization work in cotton and grain has legal force.

Permissive standards for most field products and for the principal classes of livestock and meats have been developed by the Bureau within the last 18 years. Use of these standards, although optional, is increasing steadily, and, in the case of some products, forms the basis for most of their wholesale distribution.

Voluntary inspection and grading service has developed extensively along with the development of the permissive standards. Trained inspectors, at the request of financially interested persons, determine the grade and quality of products offered for inspection and issue certificates as to their findings. In trade disputes these certificates are prima facie evidence in all courts of the United States, and afford a basis for settlement in terms of definite commodity standards. Approximately 250,000 cars of fruits and vegetables and 31,000,000 pounds of alfalfa hay have been inspected during a single fiscal year, as well as large quantities of many other commodities.

MARKET NEWS SERVICE

Side by side with its standardization and inspection work, the Bureau has developed a Nation-wide market news service covering all important farm products. This service has become an indispensable factor in the American system of marketing. Reliable information is assembled and made available in time to be used as a basis for action with respect to many problems of production and marketing. Data and interpretative statements are made available on commodity shipments, market receipts, stocks in storage, imports and exports, prices, the quality and condition of market offerings, and prospective trends of demand and supply. This information facilitates and equalizes distribution, discourages the dissemination of fictitious and misleading market information by unscrupulous persons, places the producer and his marketing organization on a more advantageous basis for bargaining with the usually well-informed buyer, promotes standardization by emphasizing market preferences, aids economic research looking to improvements in marketing methods, and provides information for adjusting production to demand.

The basic information is collected in numerous ways—by trained market reporters who interview buyers and sellers in the markets during trading hours, by telegraphic reports from the railroads on shipments to and arrivals in the important markets, by warehousemen who report stocks in storage, and by numerous contacts with other sources. It is distributed in time for practical use, and every effort is made to improve its timeliness. The Bureau operates one of the most extensive leased-wire services in the country. The information is disseminated by market flashes sent over 10,000 miles of leased telegraph lines, by frequent broadcasts over more than 100 radio stations, by the commercial news-dispatch service of the telegraph companies, and by mimeographed reports sent out daily to extensive mailing lists. Thus a picture of the market situation for each of the principal farm commodities, particularly perishables, is kept almost hourly before the interested public.

Such blanketing of the entire country with timely market information pertaining to farm products has decreased the disadvantage of the individual producer and the small shipper who are in competition with the stronger commercial organizations better capable of obtaining for themselves accurate information through far-flung trade connections. The market-news service helps to promote orderly marketing. It has greatly reduced the losses previously sustained through the blind shipment of perishables to glutted markets when other markets were undersupplied. The Federal Government is the only agency in a position to furnish such a service impartially to all concerned on commodities in which there is a Nation-wide interest.

ORGANIZATION OF THE BUREAU

The Bureau was created in 1921 by consolidating the economic work formerly done in the Bureau of Markets, the Bureau of Crop Estimates, and the Office of Farm Management. Since that time the work has expanded greatly, and the Bureau is now organized along two lines—commodity and functional. The commodity divisions are: Cotton Marketing; Dairy and Poultry Products; Fruits and Vegetables; Grain; Hay, Feed, and Seed; and Livestock, Meats, and Wool. The functional divisions are: Agricultural Finance; Crop and Livestock Estimates; Farm Management and Costs; Farm Population and Rural Life; Foreign Agricultural Service; Land Economics; Statistical and Historical Research; and Warehousing. Each commodity division of the Bureau, in addition to its permanent service and regulatory work, conducts research on many problems specifically pertaining to the commodity. Extensive research is conducted by the functional divisions in such fields as farm management, cost of production, credit, insurance, taxation, transportation, land utilization, land tenure and land values, price analysis, foreign competition and demand, and rural life. The Bureau maintains an economic library, and a Division of Economic Information devoted to the publication and dissemination of information.

The Bureau has a staff of more than 2,400 employees. More than 260 offices of the several divisions are maintained in various parts of the country. Foreign Service representatives are stationed in Europe, in the Orient, and in South America. Many of the activities of the Bureau are conducted under cooperative agreements with State departments of agriculture and markets, agricultural colleges, and State experiment stations.

RESEARCH UNDERLIES MANY ACTIVITIES

As the organization of the individual farm is fundamental to satisfactory returns in farming, the Bureau devotes a great deal of attention to farm-management research. This includes not only comparative studies of various farm enterprises in the organization of individual farms as a business but also cost-of-production studies to disclose weak points in farm practice and to aid in determining those practices that promise the best results. Moreover, attention is given to types of farming and to farm-management problems involved in adjusting output to demand, and in the shift-

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ing of regional competition. The present tendency in the Bureau is to organize farm-management research on a regional basis and to work more and more in cooperation with commodity specialists and State and local agencies.

Transportation research often follows special problems in response to requests of farmers' organizations and other agricultural agencies. These problems include, for example, the effect of changes in freight rates on production and farm prices, regional competition in farming, and local costs of equipment and other things bought by farmers.

History provides a valuable aid to the agricultural student and research worker and to others who may be called upon to aid in planning public policy in agriculture. Therefore studies in agricultural history are included in the Bureau's program.

FOREIGN WORK INVOLVES BASIC INVESTIGATIONS ABROAD

Foreign competition and foreign demand have a vital bearing on the economic position of American agriculture. Shifts in foreign production, seasonal and over a period of years, must be followed closely, must be measured and analyzed. Changes have taken place in the foreign demand for agricultural products which have an important bearing on the fortunes of the American farmer. It is the function of the Bureau's Foreign Agricultural Service to report these developments currently and to study and analyze their significance.

The current reports on crop and market conditions in foreign countries are cabled by the foreign representatives and are widely distributed in this country as a part of the Bureau's extensive domestic market reporting service. These basic data on competition and demand in foreign countries are woven into similar data on the domestic situation in order to present a world-wide review of the situation of several commodities. The development of this service has made it possible to keep currently abreast of significant developments in the foreign competition with which our producers must reckon, as well as developments in the foreign outlets for their products.

In addition to current developments in foreign countries, American farmers must take cognizance of basic changes or trends in the competition with or market for their cotton, tobacco, wheat, pork products, and fruit. A number of studies of this character have been made or are now being made by members of the Foreign Agricultural Service. The potentialities of cotton production in Egypt have been carefully investigated. Expansion of the cotton area depends upon developments in the land-reclamation program in Egypt, but a tendency to shift from low-yielding, long-staple varieties of cotton to higher yielding, short-staple varieties may increase Egyptian production with little or no change in the cotton acreage. A study has been made of tobacco production, consumption habits, and demand for American leaf in each country in Europe. The study represents a basic examination of the European demand for American leaf and of the changes that are taking place in this demand. A study of the factors determining the varying consumption of American cotton in

the Japanese spinning industry has been completed and a similar study is being made in China. Other investigations cover competition with and demand for our wheat, pork products, and fruit, and illustrate the fundamental character of the information on foreign conditions being secured by the Foreign Agricultural Service and being made available to American farm interests.

LAND PROBLEMS FUNDAMENTAL

Utilization of our land resources is one of the most important subjects studied by the Bureau. Land-utilization studies yield significant and valuable results to the general public. They point the way toward better State, regional, and national land policies. Such studies involve estimates of quantity and quality of the land resources of the Nation available for the various major uses; the need for land as affected by changes in population, foreign trade, domestic consumption, and efficiency of production; important regional shifts in the uses of land and their significance; and the outlining of policies that will tend to bring about desirable adjustments in the use of land.

Studies are also made of the problems of land utilization in particular local areas, especially those where important changes have disturbed the economic balance, resulting in extensive tax delinquency and farm abandonment. Such studies are pointed toward the objective of supplying a sound basis for the necessary replanning of the economic and institutional life of the area, with particular emphasis on the elimination from production of areas poorly adapted to cultivation and on needful regrouping of the population.

Methods used in selling land and in promoting settlement in particular areas are studied with a view to preventing disappointment and loss to the State and to the settlers; to developing the most efficient and economic methods of land use; to directing rational agricultural expansion or contraction whenever the desirability of such expansion or contraction may be indicated.

Closely related to these lines of research are studies of land tenure and farm real estate. The Bureau is obtaining a more complete knowledge of how the farm land of the United States is owned and of the relation of such ownership to the welfare of all groups and of the Nation. Study is devoted to the extent and significance of farm tenancy and the problems of fair and harmonious adjustment in the tenant contract and in the relationship of landlord and tenant.

The farm real-estate situation is surveyed annually to determine the volume of voluntary and of forced sales, the number of foreclosures, the changes in farm land values, and the influence of the several factors that affect these values. Effort is being made to measure the forces that determine land value as a basis for better methods of appraising land for sale, taxation, or credit. In cooperation with other bureaus, assistance has been rendered the War Department in the valuation of extensive areas in territory affected by the floodway project in the lower Mississippi Valley. All this work is contributing toward the gradual formation of a conscious national land policy.

CONDITIONS AMONG FARM POPULATION

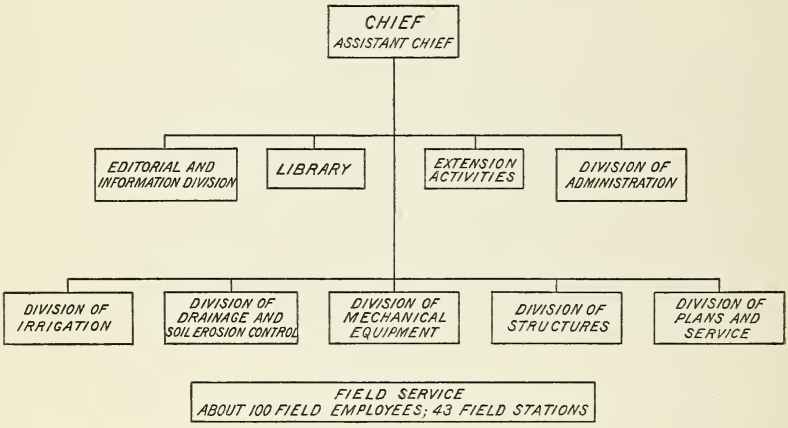
The currents of movement to and from farms have been looked upon by many leading economists as constituting an index of the state of the economic health of agriculture. Farm owners are often slow to shift their occupation under economic pressure, but farm laborers respond quickly. When methods have been worked out whereby accurate current statistics can be secured with regard to the movement to and from the farm, we shall have an index that in more normal times will respond promptly to changes in agricultural welfare relative to that of other industries. The Bureau is constantly improving its methods of studying these movements.

Better production at lower costs, improved markets, better prices, and increased income have as a final objective, so far as farm families are concerned, the improvement of the rural standard of living. To facilitate such improvement, studies are made of various phases of the rural population and rural methods of living.

ADMINISTRATION OF LAWS

Regulatory acts of an economic character administered by the Bureau include: The Cotton Futures Act, the Grain Standards Act, the Warehouse Act, the Cotton Standards Act, the two Standard Container Acts, the Produce Agency Act, the Perishable Agricultural Commodities Act, and the Tobacco Stocks and Standards Act. As the processes of marketing become increasingly complex there is an increased demand for certain improvements through legislation. Economic and practical analysis precedes the formulation of the regulations under any act that is intrusted to the Bureau for administration, and the current problems that are brought to light, in the course of administration, are given close study in a search for remedies.

BUREAU OF AGRICULTURAL ENGINEERING



BUREAU OF AGRICULTURAL ENGINEERING

The Bureau of Agricultural Engineering deals with those phases of agriculture that are included within the field of engineering. The chief activities of the Bureau are the conducting of research on specific engineering problems, the results of which, when applied, tend to reduce production costs, improve the quality of the products, and raise the standard of living on the farm.

The engineering problems of agriculture fall within two main groups, namely, those which concern the improvement of the land and those which deal with the equipment and structures used in agriculture. The land-improvement group includes land clearing, irrigation, drainage, and control of soil erosion. The other group comprises farm power and machinery, rural electrification, farm buildings, and the engineering problems involved in the transportation and storing of perishable products. The research work of the Bureau is done chiefly in cooperation with other bureaus of the Department of Agriculture, the State agricultural experiment stations, and other appropriate agencies chiefly those maintained by public funds. The results of investigations are published as bulletins of the Department or prepared for distribution in mimeographed or blueprint form.

A function of the Bureau is to render to other bureaus of the Department engineering and architectural service needed in connection with the acquisition and improvement of land, the designing of buildings and other facilities, and the purchase of mechanical equipment required in the work of those bureaus.

BUREAU CREATED IN 1931

The Bureau of Agricultural Engineering was created under the provisions of the Agricultural Appropriation Act, fiscal year 1932. For about 10 years prior to July 1, 1931, this unit functioned as the Division of Agricultural Engineering of the Bureau of Public Roads. The newly-created Bureau represents the consolidation of the various agricultural engineering activities of the Department for which Congress has appropriated funds from time to time. The first of these was irrigation investigations, provision for which was first made in 1899. A few years later funds were provided for drainage investigations. Both of these units functioned under the Office of Experiment Stations. Prior to 1915 some work had been done by various bureaus of the Department in the field of farm machinery and farm structures. In 1915 all the drainage, irrigation, farm-structure, and farm-machinery activities were allocated to the Office of Public Roads, which in that year was made the Office of Public Roads and Rural Engineering and later became the Bureau of Public Roads. In 1920 a Division of Agricultural Engineering

was established, comprising the purely agricultural engineering activities of the Bureau, and since 1926 appropriations for the Division have been made by Congress in lump sum.

IRRIGATION

Work of the Division of Irrigation deals with studies of the utilization and apportionment of the water for farm irrigation and with the organization, operation, and maintenance of irrigation enterprises. Studies are directed particularly toward the problems of economic handling and utilization of water after it is delivered to the farm, as distinct from those of the primary storage and conveyance of irrigation water. The investigations involve, in general, systematic and long-continued observation of experiments conducted, in most cases, in cooperation with the agricultural experiment stations of the Western States.

The quantity of irrigation water that it is necessary to apply to different crops under various climatic and soil conditions has been the subject of study for many years. These investigations have been carried on cooperatively in a number of the Western States.

The use of water by noneconomic growths, such as weeds, willows, and aquatic plants also is being studied in California, the better to determine the water losses that must be provided against in developing irrigation supplies and the economy of eliminating such growths from the margins of reservoirs and canals.

Extensive records have been made of rates of evaporation from free water surfaces, such as irrigation reservoirs, under various climatic conditions and at elevations ranging from below sea level to more than 14,000 feet above sea level, such data being of considerable importance in planning the storage of irrigation water.

The wastage of water during flood flow of streams in the arid West attracted attention many years ago, and suggested the possibility of utilizing this excess off-season flow. The matter has become more prominent in recent years, owing to the overdraft on underground water supplies in many localities and the consequent lowering of the water table. In cooperation with the California Department of Public Works, studies are being made to determine the feasibility and methods of spreading flood waters over porous lands so that they will percolate into the soil and be available for future use.

Studies of the customs, regulations, and laws relating to irrigation deal with the different types of irrigation organization in the West, such as the commercial district, the irrigation district, and the mutual irrigation company. They include collection and analysis of data relative to policies governing ownership of return waters from irrigation, and formulation of principles for State legislation regarding appropriation and use of underground waters. Cooperative investigations have been made of the engineering, agricultural, and general economic status of a number of irrigation districts as a means of developing plans for the rehabilitation of such districts as in recent years have fallen into financial difficulties.

Investigations are conducted relating to the characteristics of flow in various types of irrigation channels and conduits. Studies are being made for the development of water-measuring devices, and of devices to trap out of streams the heavy loads of detritus that if

carried into irrigation ditches would damage those ditches or necessitate large expenditures for removing the deposits. The latter studies are being made principally in Colorado in cooperation with the Colorado Agricultural Experiment Station, where suitable facilities for such work are maintained.

Irrigation in the eastern or humid section of the United States is chiefly to supplement the annual rainfall which at times proves inadequate, especially for the best growth of truck crops. The two types chiefly used in the East are spray irrigation and surface irrigation. There is under way, in cooperation with the New Jersey Agricultural Experiment Station, an experiment to determine the feasibility of using city and institutional sewage for irrigating crops.

DRAINAGE AND SOIL-EROSION CONTROL

The drainage work of the Bureau involves investigation of the design, construction, operation, and maintenance of drainage structures, and of the organization and development of drainage districts. The chief purpose of these investigations is to discover fundamental facts and develop data that will result in more effective and economical practices in the draining of agricultural land and in the prevention and correction of soil erosion.

In the design of drainage systems, one of the fundamental problems is the determination of the amount of water that the system may be required to handle, and extensive studies have been in progress for many years to determine the relation of run-off to rainfall. A large amount of data have been collected, applicable to various sections of the United States, chiefly east of the Rocky Mountains. Drainage is concerned with the maximum rates of run-off rather than with average or normal rates. These maximum rates are affected by type of vegetation, kind of soil, and character of topography, among other factors. Allied to the subject of run-off, as a basis for drainage design, is that of the water capacity of drainage channels as affected by the roughness of the channel perimeter. Studies of this feature are also being carried on.

Studies are made of the drainage requirements of certain types of soil, consideration being given at present to control of ground water by drainage and irrigation together in sugarcane lands of Louisiana and in peat and muck soils of Florida.

Field studies have been made to determine the most economical equipment and methods for pumping drainage water, a practice that is followed extensively by drainage districts along the Mississippi River and its tributaries in Illinois, Missouri, and Iowa. The information obtained from these studies will be of outstanding interest to drainage districts in the territory affected for application in obtaining greater economy in the disposal of large volumes of drainage water.

In cooperation with the State University of Iowa, at the laboratory of the university at Iowa City, experimental investigations are under way that deal with various phases of flow in drainage channels, especially as to the effects of bends and bridge piers and other obstructions. In general, the purpose is to determine the coefficients that are applicable to standard formulas for flow under conditions presented by such obstructions.

For more than 10 years the Bureau has been conducting investigations the object of which is to develop drainitile resistant to soil alkalies and acids. Many thousands of test specimens prepared under various formulas and subjected to different curing treatments have been immersed in laboratory solutions of different strengths and in a natural alkali lake in South Dakota, the waters of which simulate in some respects the conditions to which draintaile is subjected in the area under investigation. The specimens are closely examined and tested from time to time. In the course of these studies valuable information has been obtained with reference to the manufacture and curing of concrete tile. Studies have also been made of the resistance of tile to frost, and of means for making tile more frost resistant.

The general plan followed in the investigation of the control of soil erosion is to establish, on the soil types most subject to erosion, experiment farms on which all of the factors involved may be studied over a period of years. Ten such farms have been established and are in operation. These are located in Oklahoma, Kansas, Missouri, North Carolina, Texas, Washington, Iowa, Wisconsin, and Ohio. The work is being done in cooperation with the Bureau of Chemistry and Soils, the Forest Service, and the respective State experiment stations. The studies of the Bureau of Agricultural Engineering on this project are primarily concerned with the control of erosion by artificial structures such as terraces, tile drains, check dams, and soil-saving dams, and with the use and development of machinery for the cultivation of terraced land. Comparisons are obtained of the quantities of soil and of water lost from terraced and unterraced lands, and measurements are made to determine the proper size, spacing, and slope for terraces in relation to rainfall and land slope on different types of soil.

The Bureau of Agricultural Engineering is assisting the Forest Service in supervising the gully-control work that is being done by the Civilian Conservation Corps, and in the organization of erosion- and flood-control camps.

FARM LAND DEVELOPMENT

In several States considerable interest has developed in the possibility of effecting a large reduction in agricultural production costs by following a well-planned program with respect to the utilization of land. In carrying out such a program the engineering features, with which this Bureau is concerned and regarding which investigations are in progress, relate to the placing of farms in best physical condition and equipping them most suitably for profitable utilization. The factors studied include the sizes and shapes of the fields; the removal of stumps, stones, and other impediments to cultivation; the economical measures for drainage and for erosion control; practical improvements in the farm buildings; and selection of farm machinery of most useful types and sizes. In furtherance of this study, selected farms in various States are surveyed and tentative plans of development are made for consideration with the farm owners. Cooperating State experiment stations are obtaining records of the resulting financial benefits as the improvements are made by the landowners.

FARM MECHANICAL EQUIPMENT

Work under this head deals with power and other mechanical equipment employed in the various farming operations. The investigations consist chiefly of research projects dealing with the fundamental requirements of machines, the results of which, when applied, tend to lower the cost of producing crops.

One general line of research has been the use of mechanical equipment in combating insect and other pests. In the Department's program directed toward the control of the European corn borer, studies have been carried on for several years to develop new machines and attachments to existing machinery which, when used in ordinary farming operations, tend to destroy the borer. One of the most effective means of controlling this pest is to obtain complete coverage of cornstalks and debris when plowing. Measures for control of the pink bollworm are being studied, involving equipment with respect to the effectiveness of plowing, irrigation, and destruction of unpicked bolls and of plants, and with respect to satisfactory disposal of gin trash which affords harborage for the insect. Tests are being made of the effectiveness of certain tillage machines for destroying Japanese-beetle grubs. Studies of spraying equipment for controlling insect pests and diseases in pecan orchards have been undertaken. The investigations are carried on in cooperation with other bureaus of the Department, including those of Entomology, Plant Quarantine, and Plant Industry, and with certain State agricultural experiment stations. The work on European corn-borer control is conducted from headquarters at Toledo, Ohio, and at Moorestown, N.J.; that on pink bollworm control at Presidio, Tex.; and that on spraying equipment at Albany, Ga.

Methods and costs of drying forage crops are being studied at Jeanerette, La., in cooperation with the Bureaus of Animal Industry, Dairy Industry, and Plant Industry. Two experimental driers of different types have been designed and installed and the tests being made include wilted and crushed as well as freshly cut forage. Experiments in drying of rice and of wheat also have been made, elsewhere, in cooperation with the Bureau of Agricultural Economics.

Investigations of fertilizer distributors, conducted in cooperation with the Bureau of Chemistry and Soils and a number of State agricultural experiment stations, are designed to develop more satisfactory machines for distributing commercial fertilizers accurately with respect to rate of application and to placement in relation to the seed.

The economical use of machinery in crop production is the subject of a series of studies, generally conducted in cooperation with State experiment stations. Investigations have been undertaken in certain States to develop machinery by the use of which the cost of producing cotton in the Southeastern States can be reduced. In the North Central States investigations generally similar are being made with respect to machinery for economical production of corn. A study of machinery used in the production of sugar beets, undertaken in 1930, is designed to develop equipment applicable to growing and harvesting this crop and thereby to enable the growers to

avoid some of the serious labor problems that confront them under present conditions.

The investigation of cotton ginning, in cooperation with the Bureau of Agricultural Economics, originated in a special appropriation made by Congress in the fiscal year 1930. A comprehensive experimental study is being made of the equipment and processes involved in conditioning, cleaning, and ginning seed cotton, with the object of overcoming some of the difficulties involved in obtaining satisfactory lint quality and in operating the machinery. A laboratory for these studies has been built and equipped at the Delta Branch Agricultural Experiment Station at Stoneville, Miss.

FARM STRUCTURES

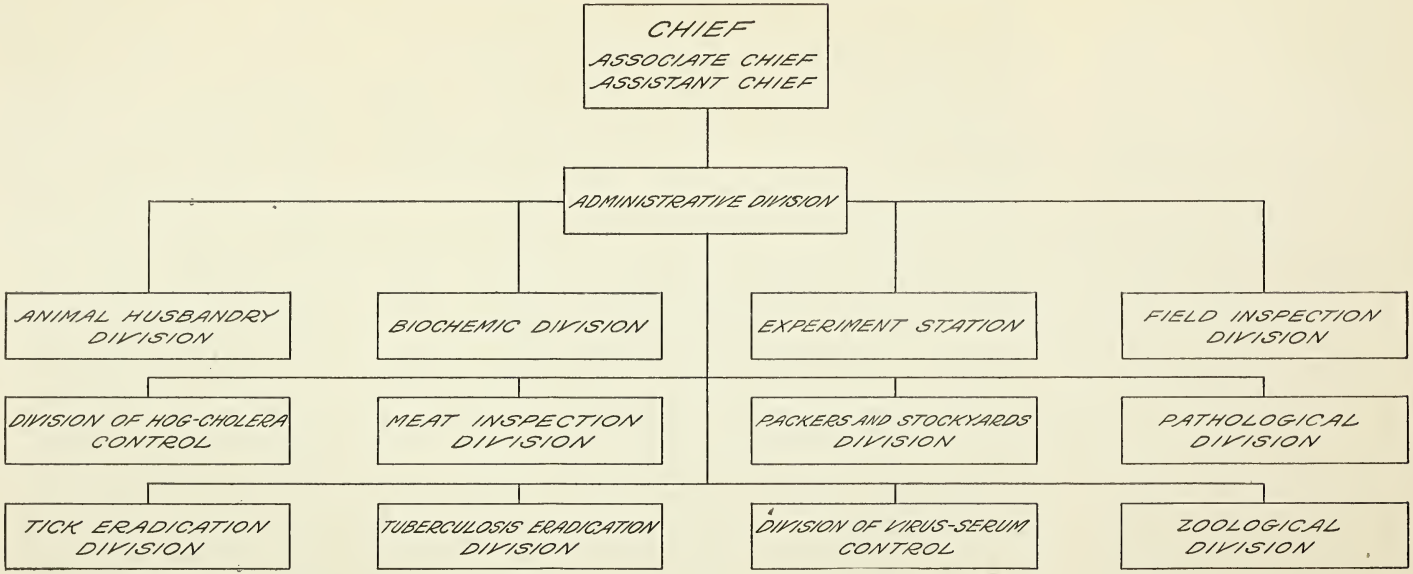
The subject of farm structures as dealt with by the Bureau includes the farm home and its lighting, heating, sewerage, and water supply; other structures of the farmstead, such as barns, poultry houses, hog houses, granaries, and machine sheds; and small community buildings such as potato and apple storage houses for handling the produce of several farms. The purpose of the researches is to find how farm buildings can be made to contribute more to the comfort, efficiency, and health of the family, and to a reduction of the cost of crop and livestock production and marketing. Practical ways of remodeling and modernizing farm homes, as well as of planning new dwellings, are being studied.

Methods and materials of construction are being studied, from the viewpoints of economy and service. The investigations comprise bracing to resist wind, use of rammed earth and of canvas for walls of buildings, and determination of stresses in corncribs.

The design and construction of dairy barns has been the subject of a cooperative investigation in Wisconsin to determine how much protection dairy cows need for efficient production of milk, and how this protection can be provided economically. The problems of requirements and facilities for lighting and ventilation are included. Suitable types of construction for potato-storage houses are being investigated, supplementary to recent studies on storage of potatoes in Maine and of sweetpotatoes in Virginia. The heat given off by fruits and vegetables in storage is being measured to provide a basis for better design of equipment for storing and transporting these products.

The insulation of refrigerator cars used in transporting fruits and vegetables is also receiving attention, with the object of finding means whereby the costs of icing or of heating may be lowered and the losses by deterioration of the products in transit may be reduced. Records of temperatures obtained inside the cars are related to methods of icing or heating, outside climatic conditions, and car construction, being affected even by the color of the paint on the outside of the car. The arrangement of cooling coils in cold-storage rooms to give uniform temperatures and satisfactory degrees of humidity, the use of mechanical refrigeration on dairy farms, the use of low-pressure steam for sterilizing soil, and heating equipment for farm dwellings and greenhouses, are other research projects of the Division of Structures.

BUREAU OF ANIMAL INDUSTRY



FIELD SERVICE

APPROXIMATELY 4,400 FIELD EMPLOYEES; 770 MEAT INSPECTION ESTABLISHMENTS IN 270 CITIES; 90 STOCKYARDS SUPERVISED; INSPECTORS AT 38 PORTS OF ENTRY, AND IN ALL THE STATES; EXPERIMENTAL FARMS AND RESEARCH LABORATORIES AT 20 POINTS

THE BUREAU OF ANIMAL INDUSTRY

The activities of the Bureau of Animal Industry, established in 1884 by act of Congress, are essentially devoted to the protection and betterment of the Nation's livestock industry.

The basis of operation includes: Problems of research, involving the cause, prevention, and treatment of diseases of domestic animals; experimental projects in breeding, feeding, and management; investigations on the existence and spread of communicable diseases of animals; and the administration of livestock laws and regulations.

For the performance of these activities the Bureau has been organized on a basis of divisions which deal with major lines of work. For facility and economy of operation, administrative functions common to the entire Bureau are grouped in the office of the chief. These include principally the determination of general policies and supervision of all activities. Among such administrative functions are the preparation of estimates of expenditures, supervision of personnel; accounting, legal, editorial, and exhibit work; and related administrative work.

PRINCIPAL LINES OF WORK

The divisions, which operate under the general supervision outlined, are engaged in the following activities:

Animal Husbandry Division.—Conducts investigations and experiments in feeding, breeding, and management of livestock and poultry and also studies the quantity and quality of their products.

Biochemic Division.—Conducts biochemical and bacteriological research concerning animal diseases, meat products, and disinfectants. Produces tuberculin and mallein. Analyzes dips and disinfectants.

Experiment Station.—Conducts investigations, principally of animal diseases. Its facilities are used by the various divisions.

Field Inspection Division.—Has charge of eradication of sheep, cattle, and horse scabies, dourine, anthrax, etc. Has supervision of import and export livestock, supervises work related to imports of hides, skins, wool, hair, and similar products, especially with regard to danger of infection of animals by these commodities.

Division of Hog-Cholera Control.—Carries on the field work against hog cholera. Directs field forces, in various States, engaged in the investigation, suppression, and control of outbreaks of hog cholera and other infectious diseases of swine.

Meat Inspection Division.—Conducts Federal meat inspection at slaughtering and processing establishments engaged in interstate and foreign commerce. Supervises transportation of meats. Inspects imported meats.

Packers and Stockyards Division.—Administers Packers and Stockyards Act; conducts inspection of livestock at market cen-

ters; and enforces the 28-hour law, which provides for proper feeding, watering, and humane handling of livestock shipments.

Pathological Division.—Conducts laboratory work relating to animal diseases, their control and suppression, including bacteriological and pathological investigations of causes of disease.

Tick Eradication Division.—In cooperation with authorities of various Southern States, conducts work of eradicating cattle-fever ticks.

Tuberculosis Eradication Division.—Conducts eradication of tuberculosis from cattle, swine, and poultry, in cooperation with State authorities and individual owners.

Division of Virus-Serum Control.—Has charge of regulatory work in the enforcement of the Virus-Serum-Toxin Act aimed to insure a high quality of commercial viruses, serums, toxins, and similar products for combating animal diseases.

Zoological Division.—Conducts laboratory and field investigations of animal parasites. Studies methods of treatment of animals and of controlling parasites under farm conditions.

EXTENSIVE ACTIVITIES

In order to conduct the foregoing lines of work most satisfactorily and economically, the Bureau maintains numerous field offices, experimental farms, and laboratories. Much of the work is conducted independently, but disease-control and research studies are commonly handled in cooperation with State officials, other bureaus of the United States Department of Agriculture, and stockmen.

To carry on these many lines of endeavor the Bureau has a personnel of approximately 4,200 employees, more than 90 percent of whom are stationed outside of Washington. These persons are selected for particular training and fitness for one or more duties. The employees are distributed among all the States of the Union and several foreign countries.

EARLY GROWTH AND DEVELOPMENT

The first major task of the Bureau, after its creation in 1884, was the eradication of contagious pleuropneumonia which, for a number of years, had caused serious losses in livestock herds of eastern States. This disease was entirely stamped out in 1892 and has never since regained a foothold in the United States.

The next important achievement was the establishment of a comprehensive and effective meat-inspection system which is recognized abroad as well as in the United States. The Federal Meat Inspection Act of June 30, 1906, is the cornerstone on which the present extensive, thorough, and economical meat-inspection system has been built.

Seven outbreaks of foot-and-mouth disease in domestic animals have been successfully suppressed by the Bureau of Animal Industry and cooperating States. This plague takes a heavy toll abroad. It is the object of special precautions for the protection of the livestock industry of the United States against its introducion from infected countries. Rigid quarantine measures, together with a well-trained veterinary personnel, ready to cope with outbreaks promptly and

vigorously, are the means by which this country maintains its fortunate freedom from this disease.

From time to time Congress has assigned to the Bureau added duties and responsibilities. These have included the administration of the Virus-Serum-Toxin Act of 1913, the purpose of which is to insure a high quality of veterinary biological products, and of the Packers and Stockyards Act, enacted in 1921, which provides for supervision of the principal stockyards and of the commission firms and dealers engaged in business at such stockyards. This supervision also includes any packing house at these stockyards and elsewhere.

The Bureau's development has witnessed also such undertakings as the eradication of the destructive cattle ticks of the South, the control of hog cholera, and the eradication of tuberculosis from the livestock of the entire country. Enterprises such as these entailed, as the first step, the development of sound methods of procedure. Tick eradication is now more than four fifths completed; hog-cholera losses in recent years have been much less than formerly; and tuberculosis of both cattle and swine is declining, according to extensive post-mortem data. In addition, the Bureau conducts vigorous campaigns against such parasitic pests as cattle and sheep scabies, roundworms of swine, and stomach worms of sheep.

In the field of animal husbandry, investigations have resulted in much useful information on raising domestic animals, with special reference to low costs of production, early maturity, and high quality of marketable animals and their products. The Bureau has sponsored likewise a Nation-wide campaign of livestock improvement based principally on the use of carefully selected purebred sires.

The essential results of these research and regulatory activities are presented to the public in annual reports, in scientific and popular publications, and through other channels such as exhibits and radio. Besides being an extensive source of information to the livestock industry and the public, the data are valuable also to public officials in dealing with new problems that constantly arise in connection with economic, legislative, and administrative questions.

Federal meat inspection, for instance, though established primarily to insure wholesome meat food products, has been productive also of valuable records. These show the number of animals offered for slaughter throughout the year at federally inspected establishments and the condition of such animals with respect to diseases and other ailments.

The highly gratifying results that have attended research and veterinary work in disease control are useful likewise in approaching problems yet unsolved. One of these is the need for more satisfactory methods of combating animal parasites in addition to those for which control methods are already known.

Another problem confronting the livestock and meat industries is the lack of exact knowledge of factors that influence the quality and palatability of meats. This question is highly intricate in view of present evidence that such factors include the heredity of food animals as well as the conditions under which they are raised and fattened for market. Methods of handling and cooking the meat

after animals are slaughtered are likewise involved. Hence investigations in this field necessitate extensive cooperative arrangements with specialists in several fields outside of the Bureau's organization.

Unusual climatic conditions, such as excessive rainfall or drought, commonly result in demands from the industry for assistance in meeting the new livestock problems that arise. The movement of large numbers of cattle and other animals, for instance, from flooded areas has at times complicated the conduct of tick eradication. Drought, on the other hand, has resulted in difficulties of feeding livestock, in providing adequate water supplies, and maintaining proper crop rotations. Temporary surpluses of grain, such as wheat, have resulted in numerous demands for information on the best methods of feeding this grain to different classes of livestock.

ORGANIZATION COMBINES STABILITY AND FLEXIBILITY

From the foregoing examples it is clear that the Bureau's organization and activities must be sufficiently stable to insure continuity of major projects and yet flexible enough to render practical help in emergencies and special problems that arise unexpectedly. By training key men along versatile lines and shifting employees from one division to another to meet special needs, the Bureau endeavors to meet such responsibilities. In recent outbreaks of serious diseases, for instance, adequate forces of trained veterinarians have been marshalled for active duty in the affected localities within 48 hours.

CURRENT WORK

Though printed reports of current work obviously become historical in a very short time, a brief description of several lines of such work will acquaint the reader with the manner in which the Bureau operates or obtains data with which to answer livestock questions.

A recent survey of the animal-disease situation shows that of 35 important maladies that afflict livestock in various parts of the world, only 24 are known to be present in the United States. Of these, 17 are being effectively controlled or are approaching complete eradication. The remainder are under partial control or are the object of futher investigation.

To prevent the spread of scabies in cattle and sheep the Bureau of Animal Industry is cooperating with the livestock sanitary authorities in the control and eradication work. Whenever an infected herd or flock is discovered, the animals are dipped in a lime-sulphur or nicotine bath in order to destroy the scab mites. The interstate movement of affected animals is prohibited by law. Exposed animals may be shipped from one State to another after at least one dipping. Exceptions are made when shipments of exposed animals are consigned for immediate slaughter and precautions taken to prevent further infection. When inspectors at a public stockyard discover any trace of scabies in a shipment, the sanitary officials and the Federal authorities in charge of livestock-disease control in the State where the shipment originated are promptly notified. Measures are then taken to locate and treat any affected animals in that locality.

Dourine is a disease which affects horses and asses and is transmitted by the act of breeding. This disease has been practically eradicated from the United States, and the only locality where it is now known to exist is a small part of the range country in northern Nevada, southern Idaho, and eastern Oregon. Formerly dourine was present also in Montana, North Dakota, South Dakota, New Mexico, Wyoming, Nebraska, and Iowa. It was most prevalent on Indian reservations in some of these States. The perfection of the complement-fixation test in recent years has been an aid in detecting the presence of dourine.

At the principal livestock markets, about 50 in number, employees are stationed who make inspections of livestock received and administer the regulations. Authority to exercise such control was given to the Department of Agriculture by acts of Congress. Approximately 150 Department employees are engaged in this work. Any animals infected with or exposed to a communicable disease must be properly treated or disposed of in such a way as to prevent the spread of the disease. It is thus possible to trace diseased shipments to their point of origin. Local authorities are thereby able to apply prompt control and eradication measures, and to prevent the further movement of diseased or exposed animals.

Another important part of this service is supervision over the cleaning and disinfection of all cars that have been used in the transportation of animals affected with communicable diseases. Normally between 15,000 and 25,000 cars are cleaned and disinfected under supervision annually either to conform with the regulations or on the request of Canadian and State officials or transportation companies.

To prevent the introduction of animal diseases into the United States importations of livestock are controlled by permits. United States quarantine officials will not issue permits for cattle, other domestic ruminants, and swine from countries where any serious diseases exist. Even when permits are issued the animals are carefully inspected, quarantined, and sometimes tested, at the port of entry, to detect the presence of any disease. Animal byproducts, such as hides, skins, hair, and wool—also hay, straw, and manure—must be declared free from infection prior to shipment or be handled under careful restrictions after arrival at the port of entry.

In its efforts to improve the quality of livestock the Bureau investigates the breeding and raising of domestic farm animals and poultry and studies their products. Beef-cattle investigations, conducted in cooperation with State experiment stations, deal with production, wintering, and fattening in the principal cattle-producing areas.

Swine investigations cover the management of breeding stock, feeder-pig production, the effects of vitamins on growth and reproduction, and conditions that cause softness of pork. Sheep and goat investigations relate to successful methods of sheep husbandry under conditions peculiar to various sections of the country. Research work with wool and other animal fibers is conducted at Bureau stations, in cooperation with several State stations. Horse studies include the production and use of light horses, the wintering of horses, the endurance and stamina of the Morgan breed, breeding of American utility horses, and the production of saddle and draft types under range conditions.

Poultry investigations include breeding, feeding, and management for increased egg production, high fertility and hatchability, low chick mortality, and the production of eggs and poultry meat of high quality.

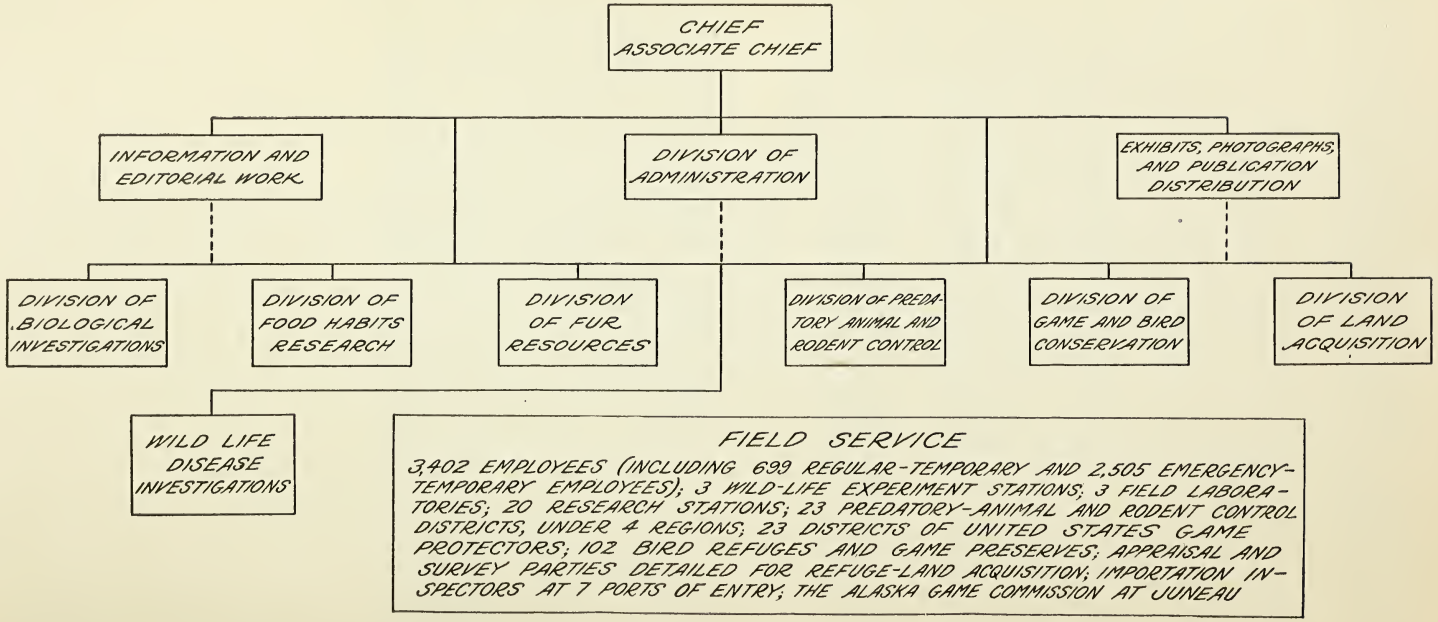
In cooperation with State experiment stations and other agencies, the Bureau conducts investigations and correlates the results of a Nation-wide study of factors which influence the quality and palatability of meat. This work includes experiments to determine the effects of chilling, ripening, curing, smoking, storing, and rendering of meats. It includes a study of yields and shrinkage in slaughtering, cutting, and processing. Principles of animal breeding are formulated through the inbreeding and crossbreeding of laboratory animals of known ancestry. They are then tested through record-of-performance studies with beef and dual-purpose cattle, sheep, swine, and poultry. Grazing studies are being made in order to determine the maximum use that should be made of grass in livestock production. The Bureau also issues certificates of pure breeding for cattle, sheep, horses, swine, dogs, and cats imported for breeding purposes.

With funds from special grants in 1933, the Bureau is to enlarge and improve the work at its experimental station at Beltsville, Md. It plans to concentrate there various investigations concerning livestock diseases and parasites.

CHIEF OBJECTIVES

In short, the Bureau is organized along lines that enable it to deal with both practical and technical problems with promise of success. Besides conducting the regular work, the Bureau's officials have as their main objectives: A better quality of livestock in the United States, improved and more economical feeding, exclusion of livestock diseases and pests from abroad, eradication or control of diseases and parasites causing loss within the United States, improvements in sanitation, humane treatment of livestock, a high standard of veterinary education, the solution of special problems through research and experimentation, the establishment and maintenance of improved trade practices at livestock markets, cooperation among various branches of the industry and helpful contacts with other industries, and the distribution of information useful to livestock producers and to the public.

BUREAU OF BIOLOGICAL SURVEY


CHIEF
ASSOCIATE CHIEF
INFORMATION AND EDITORIAL WORK
DIVISION OF ADMINISTRATION
EXHIBITS, PHOTOGRAPHS, AND PUBLICATION DISTRIBUTION
DIVISION OF BIOLOGICAL INVESTIGATIONS
DIVISION OF FOOD HABITS RESEARCH
DIVISION OF FUR RESOURCES
DIVISION OF PREDATORY ANIMAL AND RODENT CONTROL
DIVISION OF GAME AND BIRD CONSERVATION
DIVISION OF LAND ACQUISITION
WILD LIFE DISEASE INVESTIGATIONS
FIELD SERVICE
3,402 EMPLOYEES (INCLUDING 699 REGULAR-TEMPORARY AND 2,505 EMERGENCY-TEMPORARY EMPLOYEES); 3 WILD-LIFE EXPERIMENT STATIONS; 3 FIELD LABORATORIES; 20 RESEARCH STATIONS; 23 PREDATORY-ANIMAL AND RODENT CONTROL DISTRICTS, UNDER 4 REGIONS; 23 DISTRICTS OF UNITED STATES GAME PROTECTORS; 102 BIRD REFUGES AND GAME PRESERVES; APPRAISAL AND SURVEY PARTIES DETAILED FOR REFUGE-LAND ACQUISITION; IMPORTATION INSPECTORS AT 7 PORTS OF ENTRY; THE ALASKA GAME COMMISSION AT JUNEAU

BUREAU OF BIOLOGICAL SURVEY

By their very nature and relationships the game birds and mammals and the fur-bearing animals of the United States, so essential to explorers and pioneer settlers for food and clothing, have become part of the economic and social fabric of the country. The economic and recreational importance of the various species has led to wild-life research and management as a function of government, and since the many ramifications transcend State boundaries, the problem has become one of Federal concern. Fortunately for the conservation of wild-life resources, it has been appreciated that without scientific approach to the problems involved, a wastefulness of valuable forms and an ignorant persecution of some as pests would result in the extermination of many more species than have already been lost to the world during recent times.

Wild animals require not only food but areas for feeding, resting, and raising their young. This fact brings many of the better-known species into competition with farmers, orchardists, stockmen, and others who seek to extend the areas suitable for cultivation, for industrial occupation, and for human dwelling. On the other hand, many species of birds and of game, fur, and other wild mammals furnish outdoor recreation and raw materials for food and clothing, some prey on destructive insect and rodent pests, and most of them are economically harmless. It is desirable, therefore, to conserve such species and to foster their increase by protecting them, reserving areas adapted to their natural production, and propagating suitable forms in captivity.

Accordingly the study and management of certain vertebrate forms of wild life—the mammals, birds, reptiles, and amphibians—have been entrusted to a bureau of the Department of Agriculture, a "wild-life service", called the Bureau of Biological Survey. Similar operations concerned with the remaining group of wild vertebrates—the fishes—as well as with fur seals and other marine mammals, are in the field of the Bureau of Fisheries, a unit of the Department of Commerce.

The Bureau of Biological Survey is thus the agency of the Federal Government concerned with management of the country's resources in vertebrate wild life excepting fishes and marine mammals. Its complex and diversified work is based on the results of investigations in practically all parts of the United States and in adjacent countries. The more important phases embrace specialized research, propagation experiments with game and fur species, wild-life disease investigations, leadership in the control of injurious animals, acquisition, and maintenance of game preserves and bird refuges, and administration of wild-life conservation laws. In its service to the public the Bureau is meeting constantly increasing requests for information about wild life—about the economic status of the various species; the

suitability of fur and game species for propagation in captivity; the control of wild-life diseases; the protection of valuable, harmless, and interesting forms in the wild; and the repression of those with harmful or objectionable tendencies.

The Bureau was named in recognition of a form of its scientific work essential to its other activities—making surveys of the major biological regions of the continent.

HISTORY OF THE BUREAU

Studies of the migration and distribution of birds and of their food habits had been formerly pursued by committees of the American Ornithologists' Union, which was organized in 1883. The efforts of these committees resulted in the establishment of a section of economic ornithology in the Division of Entomology of the Department of Agriculture, on July 1, 1885. Within a year the new organization became an independent division and a recognized research agency in the migratory movements, ranges, economic relations, and general habits of both birds and mammals. In 1896 its designation, Division of Economic Ornithology and Mammalogy, was changed to Division of Biological Survey, and 9 years later, in 1905, when the organization became a Bureau of the Department, it was given its present name. Essentially all the lines of work originally undertaken have been continued and expanded, and new functions in law enforcement, wild-life refuge administration, fur farming, pest control, and wild-life disease investigation have been added.

During its early history the work of the Biological Survey was almost exclusively of a research nature, dealing with the habits, ranges, and classification of birds and mammals, particularly with their migratory movements and food habits. Intensive studies in these subjects in many parts of the country resulted in the publication of provisional life-zone maps of North America, details of which have been filled in from year to year as new facts have been developed on the horizontal and vertical distribution of the native fauna and flora and on their various ecological associations. This early period saw also the accumulation of voluminous data on the food habits of birds in relation to agriculture, developed by microscopic examination of stomach contents and identification of the food items by comparison with reference collections of seeds, insects, and other objects assembled and classified for the purpose. Many bulletins and numbers of the North American Fauna of the Bureau have made available to the public the results of these investigations.

The Biological Survey's program of research grows as added functions devolve upon the Bureau, and the results are published within the limits of available funds. In addition to the Department's publications, many others, issued in cooperation with various organizations, disseminate the findings of important investigations.

In 1900 game preservation was added to the functions of the Biological Survey, with the passage of the Lacey Act, and 3 years later the first of a steadily growing system of Federal bird refuges was placed under its administration by Executive order of President Theodore Roosevelt. Wild-life conservational work has been extended

from time to time, through the Alaska Game Laws of 1902, 1908, and 1925, the last also covering in its provisions the protection of land fur animals in the Territory; the Migratory Bird Law of 1913, to regulate hunting; and its successor, the Migratory Bird Treaty Act of 1918, which was supplemented in 1929 by the Migratory Bird Conservation Act, authorizing the present system of migratory-bird refuges. The last two laws were enacted to carry out the provisions of a treaty negotiated with Great Britain in 1916 for the protection of birds that migrate between the United States and Canada.

The period from 1915 to the present has witnessed not only increased attention to research, including fur-farming investigations, and enlargement of functions dealing with Federal protection of migrant birds, but also entry of the Bureau into the field of cooperative control of animal enemies of agriculture, stock raising, forestry, and game conservation. The leadership of the Biological Survey in cooperative control on an extended scale began in the fiscal year 1916 with appropriations for control of rodents and predators and suppression of rabies in wild animals. Its aid has since been requested and encouraged by State and other agencies, and the funds made available by its cooperators have far exceeded the Federal appropriations for the purpose. The Bureau's program on this line, however, has never been one of extermination but rather one of local control. In 1931 Congress authorized annual appropriations to carry out a 10-year program of predatory-animal and rodent control on public lands, in cooperation with the administering governmental agencies; and elsewhere, in cooperation with farmers and stockmen. The appropriations authorized have not thus far been made fully available.

Though new duties in the past 2 decades in Federal protection of migratory game and insectivorous birds and in the field of cooperative control of economically injurious species have greatly expanded the functions and organization of the Survey, the Bureau has given increased attention to the lines of investigation begun with the inception of the organization, improved by application of modern methods of approach. Its earlier studies have been continued and its investigations have proceeded on new lines also, with the assumption of new functions and duties, such as bird protection, fur-farming experiments, predator and rodent control, upland game-bird management, and selection of areas suitable for migratory-bird refuges. The McSweeney-McNary Forestry Research Act of 1928 has enabled the Bureau to devote more attention to studies of the relationships between forests and wild life, many species of which are found to exert a beneficial influence on the forest, some to be important products of forested areas, and others to require local control in varying degrees.

The services of the Bureau as related to wild life are now very generally in demand in the industrial, scientific, and conservational fields, and the Bureau enjoys the cooperation of scientists and scientific institutions, State conservation commissions, and wild-life protective organizations, and of farmers and stockmen's associations throughout the country.

ORGANIZATION OF THE BUREAU

The present organization of the Bureau of Biological Survey is essentially a development and expansion of the three divisions or offices that were in existence at the beginning of the century: The work of the original Division of Geographic Distribution, modified and enlarged, is continued in the present Division of Biological Investigations. The present Divisions of Food Habits Research, Fur Resources, and Predatory Animal and Rodent Control have evolved from the original Division of Economic Investigations. The Division of Game Preservation has expanded into the Division of Land Acquisition—for refuges; and the Division of Game and Bird Conservation—including sections of wild-life refuge administration, law enforcement, supervision of foreign importations of wild animals, and through the Alaska Game Commission, protection of the wild life of Alaska. All activities concerned with disease, pollution, and related causes of waste in wild life, which had originated in three separate divisions, have been consolidated into one unit of Wild Life Disease Investigations. Business and other functions formerly handled in the Office of the Chief of Bureau have become definite units known as the Division of Administration; the Editorial Office, preparing publications and press, radio, and other informational material; and the Office of Exhibits, Illustrations, and Publication Distribution. The Division of Administration correlates general administrative procedure with the other divisions of the Bureau and conducts all work concerned with the budget and accounts, property, mails and files, personnel, travel, quarters, and other business matters.

In the 49 years of its history, the Biological Survey, under its several designations, has been directed by five chiefs: C. Hart Merriam (1885–1910), Henry W. Henshaw (1910–16), Edward W. Nelson (1916–27), Paul G. Redington (1927–34), and Jay N. Darling (1934–).

RESEARCH AND SERVICE ACTIVITIES

One of the most complete scientific studies under advanced research methods on any species of wild animal or bird was undertaken and completed by the Bureau in the Southern States in the case of the bobwhite quail. The final report, published in 1931 by the committee of cooperating sportsmen, gives detailed information on the birds, their ranges, and methods developed for controlling natural enemies and diseases, and overcoming the progressive depletion of the upland game coverts by increased production of native birds rather than by the planting of imported stocks.

Among other recent comprehensive studies of species or groups may be mentioned (1) an investigation of the life history, habits, maladies, and requirements of the elk of the Jackson Hole (Wyo.) region, particularly the southern herd that winters on the Survey's elk refuge; and (2) a series of investigations of the cause and control of the celebrated "duck sickness", a malady of waterfowl, shore birds, and other wild fowl that frequent areas of alkaline water in the West. As a result of the latter studies it was found that instead of the disease being, as first thought, an alkaline poisoning, it is

actually a form of botulism, resulting from the birds feeding in areas of decaying vegetation, and is induced by the presence of certain bacteria that thrive in stagnant water areas of above-normal temperatures.

An official contribution by the Bureau of Biological Survey, in cooperation with the Bureau of Fisheries, added a chapter on wild life to the revision in 1930 of a well-known and authoritative work on the conservation of the natural resources of the country (which formerly had discussed only minerals, water, forests, and land). Other extensive publications of the Bureau have been issued in cooperation with local agencies on the wild life of a number of the States for which adequate information had been lacking.

In cooperation with the Forest Service, the Survey in 1933 prepared chapters on wild life as a resource of the forests, for inclusion in a comprehensive report on A National Plan for American Forestry, published in two volumes, as Senate Document No. 12, Seventy-third Congress, first session.

The Bureau has also issued many official and cooperative publications on the production of fur animals in captivity, including rabbits for food also, in which are presented new facts on feeding the various species, their breeding habits, and management on fur farms.

DIVISIONS OF THE WORK

Details of the research, service, and regulatory activities of the Bureau are best presented by explaining the work of its several divisions, as follows:

The Division of Biological Investigations continues the original work of the Bureau in faunal geography, life histories, migrations, relationships, and classification of the birds and mammals and other vertebrates except fishes. Developments of the studies of relationships and migratory and other habits of birds include investigations of waterfowl abundance by specialists of the Bureau and selected cooperators, and a bird-banding project, under which volunteer cooperators are given permits to trap and band birds, returns from which are providing valuable data. Important investigations are conducted of the life history and habits of deer, elk, moose, mountain sheep, antelope, and other big-game animals to provide a sound basis for management practices, and in cooperation with the Forest Service, studies are made of the relationships of wild life to forestry, including beneficial and harmful activities of species and their productive values as game and fur. Under this Division also is maintained a wild-life experiment station in Alaska for studying the reindeer, caribou, and musk ox, and the grazing resources of the Territory.

The Division of Food Habits Research continues the studies of the food of birds, the first work on which, inherited from the American Ornithologists' Union in 1885, resulted in a comprehensive publication on the economic status of the English sparrow in America. In the course of the years, food-habits research has provided definite information also on the economic status of mammals, of reptiles, and of toads and other amphibians in relation to agriculture and forestry. Information is collected in this Division on the propagation of game

and ornamental birds, on the care of cage and aviary species, and on poisonous snakes. Recommendations are made on game farming and on methods of increasing game and attracting birds generally by providing food, water, and cover and affording protection from natural enemies. Investigations also are made of the biological suitability of areas proposed as Federal bird refuges. A research laboratory is maintained at Denver, Colo., centrally located for detailed studies of the food habits of predatory animals, rodents, and other forms of wild life suspected of having economically injurious tendencies.

The Division of Fur Resources maintains a fur-animal experiment station in the East and a rabbit experiment station in the West, and conducts cooperative investigations elsewhere for the improvement of conditions in fur farming, rabbit raising, and the production of muskrats on marshland. The experiments in rabbit production, the most extensive in the world, are developing important information on feeding and feed costs, and on improvements in breeding practices. The need for a cheaper and more abundant product than the furs trapped from the wild has made necessary the best possible development of fur farming, including the production of domestic rabbits. Trends in the fur trade are noted, and to aid so far as possible in coordinating State trapping seasons, information based on facts regarding the breeding and prime-fur seasons, as influenced by the natural life zones of the continent, is collected and disseminated.

The wild-life disease-investigations project collects information on the nature of the epizootics that cause extensive losses in wild life under natural and propagation conditions. With the advent of fur and game farming, urgent calls have come from propagators for aid in controlling losses from disease. The seriousness of the periodic disappearances of game in some districts has prompted research on cycles of abundance and scarcity to ascertain the causes of the radical declines. At field stations established in representative parts of the country, opportunities are available for experiments and observations in natural habitats. Most of the work conducted is in cooperation with State conservation departments and institutions having laboratory facilities for detailed diagnostic examinations.

The Division of Predatory Animal and Rodent Control, through four regional supervisors, each directing the work of district leaders and their cooperators, undertakes cooperative work in the United States for the control of wild-animal pests of agriculture, horticulture, forestry, stock raising, and game propagation. The control districts are for the most part bounded by State lines, in the interests of effective cooperation with officials and local agencies. The campaigns are not undertaken for the extermination even of preponderantly injurious wild animals, but for their control in areas where they menace valuable wild mammals and birds, and jeopardize economic interests and human welfare. The methods employed have measurably influenced the public attitude in this field and have aided in promoting a constructive wild-life policy, under trained leaders who constantly have in view the welfare of wild life as a whole. This work originated in a small way during the early years of the Bureau's history, chiefly for the control of rodents on public

lands, to prevent infestation of adjacent cultivated areas under private ownership. The effectiveness of operations for the suppression of rabies in predatory animals and of organized cooperative work in rodent control led to requests for Biological Survey leadership on a large scale in these undertakings.

The Division of Land Acquisition is concerned with the acquisition of suitable areas of land and water as refuges for migratory birds. The Migratory Bird Conservation Act of 1929 provides for the preservation of refuge areas for the birds in their favorite habitats along migration lanes, on breeding areas, and on winter feeding and resting grounds. When areas recommended for the purpose have been found by the Division of Food Habits Research to be biologically suitable, it is the function of the Division of Land Acquisition to make detailed examinations and appraisals in order to determine the extent of the various types of land, the soil cover, and the nature of improvements, and to ascertain ownership and market value. This Division also negotiates with the owners to reach equitable price agreements preliminary to recommendation that the Migratory Bird Conservation Commission approve the acquisition. It makes surveys of lands acquired to determine the exact acreage and to establish and mark their boundaries.

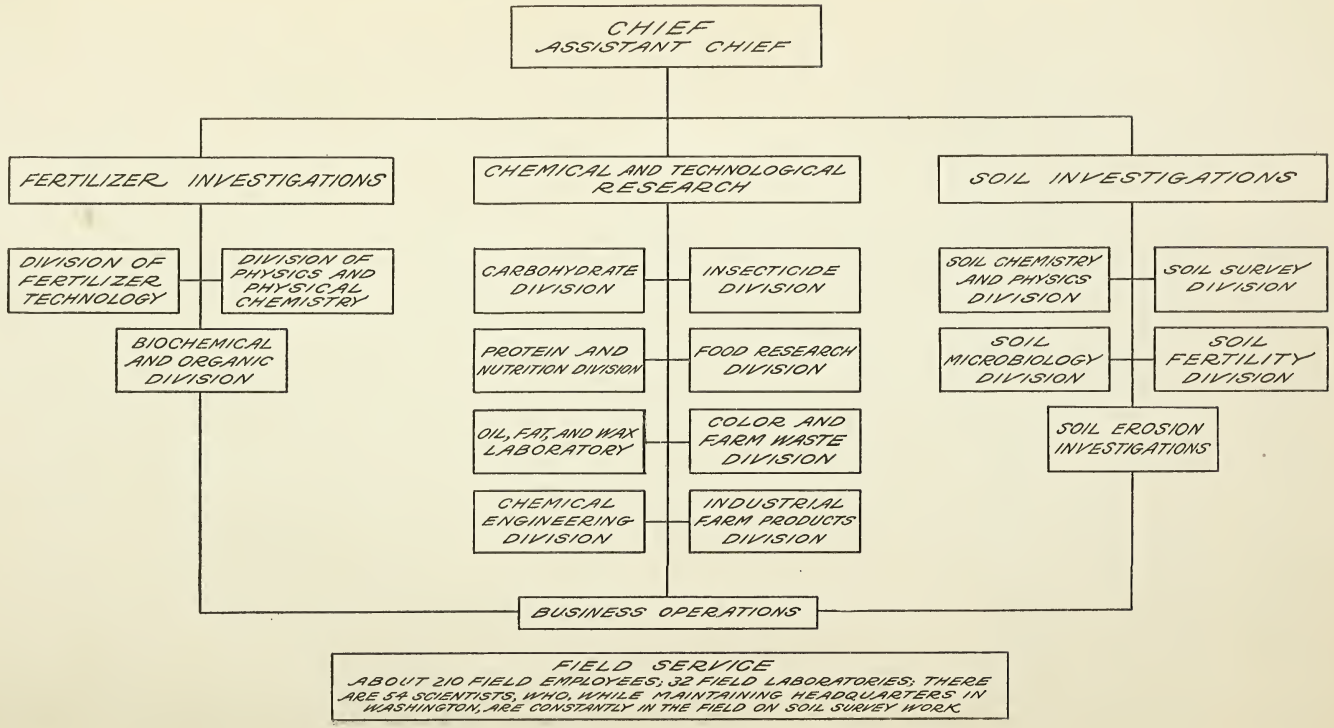
The Division of Game and Bird Conservation is charged with the administration of refuges acquired by purchase, lease, gift, or by the reservation of suitable areas of the public domain by Executive order or by act of Congress. Under this Division also is placed the enforcement of certain Federal wild-life protective laws, including the Lacey Act, governing interstate transportation of bodies or parts thereof of wild animals and birds and the importation of foreign wild species; the Migratory Bird Treaty Act, for the protection of the birds that are common property of the United States and Canada; laws protecting wild life and property on Federal refuges; and cooperation with the Alaska Game Commission in the protection of birds and land fur and game mammals in the Territory. United States game protectors are employed for the enforcement of regulations prohibiting the sale of migrant game and governing Federal open seasons, bag limits, and methods of hunting, and for the protection of migratory nongame and insectivorous birds. This Division also advises State authorities of violations of their game laws, as, for example, when in connection with illegal interstate shipments it discovers that wild animals have been killed in violation of State law. Permits are issued by this Division for the importation of foreign species, the propagation in captivity of migrant waterfowl, the possession of migratory game birds for scientific purposes, and, when investigation by the Division of Food Habits Research has shown them to be necessary, for local suppression of injurious species. The American bird-protective laws and regulations, State and Federal, the excellence of which is recognized the world over, have been built largely on the findings by the Biological Survey as to the economic value of birds.

The work of the Biological Survey, together with its numerous publications over nearly half a century, has been a potent factor in increasing the numbers of students of wild life. The Survey has been instrumental also in bringing wild-life conservationists and the

general public more and more each year to a realization that protection and restoration of game, fur, insectivorous, and other species is of vast economic and recreational importance and involves both the enactment and the enforcement of laws that have their foundation in scientific fact.

Extension of the protective principle to the fur bearers, song and insectivorous species, and other denizens of the wild, including also the game species for reasons other than sport, is being more and more demanded as our people become better informed regarding the economic and social values of wild-life management and the need of preserving areas of natural habitat. Better now than ever before the public understands the necessity of perpetuating the benefits that accrue to man through restoring and preserving in suitable wilderness areas representatives of the great variety of species still remaining in the native fauna.

BUREAU OF CHEMISTRY AND SOILS


CHIEF
ASSISTANT CHIEF
FERTILIZER INVESTIGATIONS
DIVISION OF FERTILIZER TECHNOLOGY
DIVISION OF PHYSICS AND PHYSICAL CHEMISTRY
BIOCHEMICAL AND ORGANIC DIVISION
CHEMICAL AND TECHNOLOGICAL RESEARCH
CARBOHYDRATE DIVISION
INSECTICIDE DIVISION
PROTEIN AND NUTRITION DIVISION
FOOD RESEARCH DIVISION
OIL, FAT, AND WAX LABORATORY
COLOR AND FARM WASTE DIVISION
CHEMICAL ENGINEERING DIVISION
INDUSTRIAL FARM PRODUCTS DIVISION
SOIL INVESTIGATIONS
SOIL CHEMISTRY AND PHYSICS DIVISION
SOIL SURVEY DIVISION
SOIL MICROBIOLOGY DIVISION
SOIL FERTILITY DIVISION
SOIL EROSION INVESTIGATIONS
BUSINESS OPERATIONS
FIELD SERVICE
ABOUT 210 FIELD EMPLOYEES; 32 FIELD LABORATORIES; THERE ARE 54 SCIENTISTS, WHO, WHILE MAINTAINING HEADQUARTERS IN WASHINGTON, ARE CONSTANTLY IN THE FIELD ON SOIL SURVEY WORK.

BUREAU OF CHEMISTRY AND SOILS

The Bureau of Chemistry and Soils shows American farmers, by maps and descriptions of soils, what crops their lands can best produce, and helps them, by improving fertilizers and fertilizing practices, to grow their crops with greater economy. By finding new uses for farm products it assists farmers to widen their markets and get greater returns from their crops. Upon the broad foundation of its scientific inventory of the soil fertility of more than half the agricultural area of the United States, the Bureau is working for the development of an intelligent policy of land classification, an efficient program of crop production, and wider and more profitable crop utilization.

HISTORY AND ORGANIZATION

The Bureau of Chemistry and Soils was organized on July 1, 1927, for the purpose of correlating all of the research work of the Bureau of Chemistry and the Bureau of Soils. The Bureau of Soils included in its field of research not only all investigations relating to soils but also those concerned with fertilizers and the work formerly assigned to the Fixed Nitrogen Research Laboratory. In addition to the work of these two organizations, the new Bureau took over from the Bureau of Plant Industry the Division of Soil Fertility and the Division of Soil Bacteriology. Having divorced the regulatory from the research work of the former Bureau of Chemistry, the new Bureau became primarily a research and fact-finding institution covering a wide range of subject matter pertaining to land utilization, soil fertility, fertilizer-resource development, crop chemistry, and the utilization of agricultural products and byproducts.

Within the same organization are now to be found the Soil Survey, which is laying the foundation for the mapping and study of the Nation's soil resources, soil-fertility studies having for their purpose the better utilization of the soil, and, finally, the application of chemical and engineering technology to a study of fertilizer resources and the more economical and diversified utilization of the products of the soil.

For the purpose of administration three large units are recognized within the Bureau. These are Chemical and Technological Research, Soil Investigations, and Fertilizer Investigations. Each of the three units is under the direction of a chief scientist, who not only directs the work of his unit but also serves as a member of a coordinating board within the Bureau.

Soil Investigations cover research on soil chemistry, soil physics, soil survey, soil erosion, soil microbiology, and soil fertility.

Fertilizer Investigations include research on potash and phosphate resources, atmospheric nitrogen fixation, and fertilizer production.

Chemical and Technological Research conducts investigations on the chemistry, microbiology, and technology of foods, with separate divisions working on carbohydrates, on proteins and vitamins, and on oils and fats. Investigations are also conducted on inedible agricultural products including turpentine and rosin, hides and skins, tanning materials, waxes, and ligno-cellulose crop byproducts. For the benefit of agriculture, chemical and technological investigations are conducted also on dust explosions and farm fires, insecticides and fungicides, dyes, leather, paper, and preservation treatments for fabrics.

CHEMICAL AND TECHNOLOGICAL INVESTIGATIONS

UTILIZATION OF AGRICULTURAL WASTE PRODUCTS

It is estimated that in gross tonnage farm byproducts now constitute more than 60 percent of the materials annually removed from the land. Although these materials have in them part of the farmer's assets, including the fertility of his land, his favorable climate, and his labor, the return they bring is insignificant. As so much of the cost of agriculture is represented in farm byproducts, it is obvious that their profitable utilization will result in a greater return for the farmer.

The straw, stalks, hulls, and other so-called waste cellular residues of several leading crops of the United States are estimated at an aggregate of over 260,000,000 tons with a calculated yield of approximately 115,000,000 tons of cellulose, 66,000,00 tons of pentosans, and 53,000,000 tons of lignin. The development of processes for the industrial utilization of some of this vast untapped reserve of potential wealth is being investigated by the Bureau of Chemistry and Soils. The successful solution of these problems, namely, the development of useful products from these wastes, will add many millions to the annual value of our agricultural products.

This work has steadily expanded and has become very extensive within the past 15 years. It includes investigations on fruit and vegetable byproducts, tanning materials, and lignin, a part of which is conducted in cooperation with the Iowa State College, at Ames, Iowa, where a field station has been established by the Department to study methods for utilizing our hundreds of millions of tons of cornstalks, straw, bagasse, and similar byproducts. Destructive distillation and fermentation of these wastes for the production of solvents and liquid fuels, organic acids, gas for lighting and heating the farm homes and country towns, furfural, plastics, and, indeed, any industrial method of utilization which promises to yield valuable products and additional income to the farmer, come within the scope of this work.

The Bureau is investigating lignin, one of the three great components of agricultural wastes. Lignin composes 20 to 30 percent of the dry material of the woody portion of all vegetation. It is estimated that 40,000,000 tons of this material are now lost in the waste liquor from paper mills, and in cornstalks, corncobs, straw, and other farm byproducts. Chemists of the Bureau recently found that lignin can be made to yield eugenol and guaiacol which are used in the production of certain drugs.

A few years ago an appeal was made to the former Bureau of Chemistry by the citrus-fruit growers of California to develop methods for the use of citrus-fruit culls and waste products, which were then costing the growers about $1 a ton to haul away and destroy. This call resulted in the establishment of a citrus byproduct industry, which produces valuable byproducts such as citric acid, lemon and orange oil, pectin, and other products, which in 1927 reached a total of approximately $1,000,000. Work of the Bureau on citrus byproduct utilization is now carried on at its laboratories in California, Florida, and Texas.

INCREASING THE VALUE OF AMERICAN FARM PRODUCTS

Specialists of the Bureau help the naval-stores producers by demonstrating how to make better turpentine and rosin, how to eliminate wastes, and determine how these products can better be made to meet the needs of the industries using them. Turpentine and rosin producers, whose livelihood is based upon making these and related products from the pines of the South, had received practically no scientific help until about 1900 when work was started, in a small way, in the Bureau of Chemistry. The Bureau is studying the equipment and processes of production at a naval-stores station established especially for the purpose in north-central Florida, with the view to develop the best and most economical equipment and processes, to eliminate wastes, to make higher grade products, and to adapt them better to the purpose for which they are used.

An important contribution to the chemical industry was the invention in the Department of a process for the production of phthalic anhydride by the catalytic oxidation of naphthalene. Phthalic anhydride is used in the vat dye and lacquer industries. This process has been of great value and has enhanced the value of American cotton goods. As a result of this discovery the unit sales value of phthalic anhydride was reduced to 17 cents a pound in 1927, as compared with an invoice value of 24 cents a pound in 1914, when our entire supply was imported from Germany. Research on dyes continues to be an important part of the Bureau's work.

IMPROVED INSECTICIDES AND FUMIGANTS

The Bureau has developed a number of new insecticides. The use of ethylene dichloride which was proposed some years ago for the fumigation of rugs, furs, clothing, and other household articles is steadily increasing. Another very promising new fumigant, discovered in 1927, is ethylene oxide which has proved to be very effective in the fumigation of grain, foodstuffs, and other commodities. Nicotine is one of the most valuable insecticides used by orchardists, truck-crop growers, nurserymen, and florists, but the quantity produced in recent years has been insufficient. A process for making a synthetic organic compound which is more toxic than nicotine when sprayed upon aphids has been developed. Chemists of the Bureau have found that three tropical plants—derris, cubé, and haiari—are promising sources of a new and highly effective insecticide, rotenone. Experiments by the Bureau of Entomology have indicated that rotenone is a double-acting poison more effective than pure nicotine

as a contact insecticide, rivaling pyrethrum in toxicity to many insects, and showing some promise of replacing arsenic as a stomach insecticide nonpoisonous to men or animals.

BETTER UTILIZATION OF HIDES AND SKINS

Work on tanning materials was started by the Department before 1872. Hides, skins, and tanning materials are important products of agriculture and essential raw materials for leather and leather goods, which are daily necessities in all walks of life. Both in the laboratory and in the field better methods and better practices of handling and curing hides and skins and of eliminating causes of spoilage are investigated by the Bureau. The nature and leather-making qualities of tanning materials and the methods of handling and using them are investigated. Possible new sources of tanning materials and agents are sought. In cooperation with other agencies of the Department, the possibilities in the establishment and development of foreign tanniferous plants, as new domestic agricultural crops, are investigated. The factors that influence the properties of leather and leather goods, that cause their failure or deterioration, or that add to their preservation and increase their life of service are studied and determined. Methods of utilizing tannery and leather wastes are devised. The chemical and physical properties and the serviceability of leather, leather goods, and substitutes are studied and measured.

PREVENTION OF FARM AND FACTORY FIRES

The total fire loss on farms of the United States in 1932 amounted to approximately $115,000,000. The life loss was about 3,500. Spontaneous ignition of hay alone causes a farm-fire loss estimated to have exceeded $20,000,000 in that year; there was also a serious loss from deterioration and spoilage of hay resulting from spontaneous heating which amounted to many times that sum. A careful, conservative estimate indicates that at least one tenth of our harvested grass crop is lost from the time it is cut until it is used as the result of spontaneous heating. The Bureau is studying the causes of spontaneous heating and ignition, both in the laboratory and in the field, and is developing practical measures for its prevention and control.

The losses of life and property in many of the grain-handling industries as the result of dust explosions have decreased because of the work of the Bureau. There are approximately 1,325,000 persons who are normally employed in more than 28,000 industrial establishments handling products principally of agricultural origin where dust explosions constitute a hazard to life and property. The annual value of their products is more than $10,000,000,000. The practical application of the safety measures developed by the Bureau has resulted in reduced insurance rates in grain-handling and harvesting operations. A continued increase in the number of plants handling products of agricultural origin subject to the hazard of dust explosions is a definite indication of the economic importance of this work.

Other important work of the Bureau's Chemical and Technological Research unit includes the biological investigation of foods; milling and baking problems; fundamental studies on the composi-

tion of foods and feeds; experiments on the utilization, for coloring, medicinal, and technical purposes, of raw materials; the improvement of methods for dehydrating food materials; and of preserving fruits during shipment and storing.

SOIL INVESTIGATIONS

The Soil Investigations unit is mapping the agricultural area of the United States. Since the inauguration of the soil survey in 1901 it has mapped more than half that area, or approximately 975,000,000 acres, including soils in every State and Territory in continental United States, in Puerto Rico, and in the Canal Zone. The completed soil surveys of this vast area of surveyed land (greater than the combined areas of European Germany, France, and Great Britain) provide practical working maps and handbooks to assist farmers to make the best use of their soils. They also afford an inventory of national soil resources of great and immediate value in determining governmental land policy. The information supplied by the soil survey was recently utilized in developing a basis for land classification in two States, the entire areas of which had been surveyed. Using the soil survey as the basis for soil classification in a new land-valuation program, North Dakota has enlisted the aid of the Bureau in its effort to establish a fairer basis of taxation.

In the readjustment of cotton farming in the Southeastern States, as the result of the boll weevil invasion, information on different soil types supplied by the soil survey enabled farmers to replace advantageously part of their cotton acreage with alfalfa. In the tobacco districts the soil survey has aided the farmer in selecting fields where the soil is capable of producing the quality of tobacco demanded by the market. Such information has been worth millions of dollars to farmers of the South and East. In the West the soil survey has been of incalculable value in the extension of special crops, and the avoidance of areas where accumulation of salts and developments of alkali are a menace.

Land banks, insurance companies, tax assessors, and State officials are basing their valuations increasingly on soil maps where they are available. Practically all departments of the Government make use of the soil-survey reports and maps or call upon the soil-survey experts of the Bureau for service.

COMBATING SOIL EROSION

The Bureau at its 10 regional erosion stations has established facts in regard to the extent and rate of soil erosion and has developed methods of erosion control which are of practical importance to a majority of farmers in the United States and of immediate value to the Government's program of farm relief. The Bureau's erosion surveys indicate that 35,000,000 acres of formerly cultivated land has been essentially destroyed for crop production; approximately 125,000,000 acres of land now in crops has lost all or most of its topsoil; and about 100,000,000 acres now are rapidly approaching that condition. At least three fourths of the farm land of the United States used for clean-tilled crops is subject in varying de-

grees to soil erosion, the damage from which to farm lands, roads, reservoirs, irrigation ditches, and valley lands is estimated at no less than $400,000,000 annually.

Important fundamental facts bearing on erosion control which have been obtained since the Bureau began work on this problem are: (1) Erosion varies enormously with soil character, slope, and rainfall, (2) thick-growing vegetation is the most powerful agency of erosion control, and (3) practical measures for erosion control call for extensive use of trees and thick-growing vegetation, as grass, clovers, lespedeza, etc., on the steeper slopes and the more erosive soils; practice of those rotations which keep the land under soil-saving crops part of the time; maintenance in the soil of a good supply of absorptive vegetable matter; use of tillage operations favoring increased absorption of rain water such as contour cultivation and scarification of the land; and use of engineering structures, such as terraces and soil-saving dams.

SOIL-FERTILITY INVESTIGATIONS

In order to evaluate the fertility of the most prominent soil types on which our major crops are produced and to determine their plant-food requirements, the Bureau is conducting a program of soil-fertility work in cooperation with State agricultural experiment stations. Soil-fertility and fertilizer problems relating to cotton, potatoes, sugarcane, sugar beets, and truck, citrus, and nut crops have been solved by this work to an extent which has materially aided farmers to obtain a more economical return from the soil.

Research of the Bureau on fertilizer materials and complete fertilizer mixtures has disproved the old assumption that nitrogen, phosphoric acid, and potash are practically the sole dependence of crops for plant food and is showing that elements such as manganese, magnesium, zinc, copper, and the like are important additions to the list of necessary plant-food elements.

In Florida the use of manganese in conjunction with nitrogen, phosphoric acid, and potash has made possible the use of large areas for the production of winter vegetables where crops failed without manganese. The annual value of the truck crops from these lands, which were formerly barren, is estimated at $3,000,000. Manganese sulphate has also proved effective in maintaining the vigor of citrus trees, producing larger yields, better quality, and better-colored fruit. Pecan rosette, a nutritional disease, has been controlled by application of zinc salts, counteracting a loss to pecan growers in the Southern States of $300,000 annually.

Soil-fertility studies by the Bureau on prominent potato-soil types in Maine, New York, New Jersey, Pennsylvania, Michigan, Ohio, and Virginia are showing potato growers how to produce their crop most economically. Field experiments on prominent potato-soil types have also shown it is practicable to use a greater proportion of the cheaper inorganic nitrogen in fertilizers than heretofore, thereby displacing considerable higher-priced organic nitrogen thus effecting important economies. The scientific determination of the proper proportion of nitrogen to use is estimated to have saved potato growers $1,000,000. Economies in the use of potash salts in fertilizing potatoes, made possible through the Bureau's cooperative field

studies, have saved potato growers about $500,000 annually, according to conservative estimates.

Soil-fertility studies on important sugar-beet soils have demonstrated the importance of using fertilizers in sugar-beet production. When such work was started by the Bureau very little fertilizer was used on sugar beets, but today most of the 720,000 acres in this crop are fertilized. On certain soil types increases of 11 tons per acre have been obtained with fertilizer, whereas other soils have shown slight response. It is estimated that sugar-beet growers' gross returns have been increased $5,000,000 through the use of fertilizers.

Strawberry growers of the South Atlantic States have profited by following practices developed by the Bureau's soil-fertility work which demonstrated that yields are increased greatly when fertilizer is applied in late summer rather than in winter. The adoption of fertilizer formulas and analyses issued by the Bureau has resulted in more viable strawberry plants, earlier berries of better quality, and larger yields.

From an average of 15 tons of sugarcane to the acre it has been shown that by the proper use of fertilizers it is practicable to produce upward of 30 tons. Determining the effect of different soil types and different fertilizers upon the composition of sugarcane also has materially aided the cane industry.

The Bureau's soil-fertility and fertilizer investigations with cotton soils embrace experimental work in Virginia, North Carolina, South Carolina, and Georgia, on 20 of the most extensive soil types devoted to cotton production in the southeastern Cotton Belt. By determining the most efficient fertilizer mixtures for specific soil conditions economy of production has been greatly aided and the farmer's income has been several million dollars greater than when fertilizers were used promiscuously without knowledge of soil requirements.

Cotton root rot causes a loss of approximately 1,000,000 bales of cotton annually. Soil-fertility experimental work has demonstrated that fertilizers containing readily available phosphoric acid and nitrogen are effective in accelerating growth of cotton plants, favoring early maturity of cotton, and retarding development of the disease on root-rot infested soils in Texas and adjoining States. The application of this information has resulted in very important savings by cotton growers.

The work of the Bureau in soil chemistry and physics has developed methods for the chemical and physical analyses of soils. The pipette method of mechanical analysis has increased the accuracy and reduced the cost of analyzing soils. Recent research on soil colloids has resulted in increased knowledge of the part these fine particles play in agricultural practice and has an important practical bearing on soil diagnosis and treatment and on the establishment of a definite standard of soil value measured in terms of productivity.

FERTILIZER INVESTIGATIONS

No problem of greater importance confronts American farmers than the maintenance of the fertility of their soils. With the increasing depletion of our soils by cropping and erosion, the problem of supplying better and more economical fertilizers becomes more

vital. The Bureau of Chemistry and Soils, in its Fertilizer Investigations Unit, devises methods for the more economical production and use of nitrogen, phosphorus, potash, and other essential plant foods. Recent researches carried on in this unit have contributed very materially toward an estimated annual saving of from $25,000,000 to $50,000,000 on the farmers' fertilizer bill.

Until quite recently, most of the nitrogen used by American farmers came from the Chilean deposits of nitrate of soda; from ammonium sulphate, a byproduct of our coke ovens; and from such vegetable and animal wastes as cottonseed meal, bones, and dried blood. Methods have now been developed for fixing the free nitrogen of the air into chemical compounds which are used as sources of nitrogen in agriculture. The fixed-nitrogen investigations led to developing a synthetic-nitrogen industry in the United States. For example, the cost of ammonium sulphate and sodium nitrate, the chief nitrogenous materials used in mixed fertilizers was decreased from about $64 and $48 per ton, respectively, in 1923, to about $22 and $24 in 1933.

The Bureau developed a process for the synthesis of urea from ammonia and carbon dioxide. Following this work a urea plant was constructed and successfully operated by industry in this country, the output of which is an important factor in the fertilizer field. Since the introduction of synthetic urea the price of urea has fallen from 30 cents a pound in 1919 to about 4 cents in 1933.

A method recently devised by the Bureau for treating peat with ammonia has furnished a material containing up to 20 percent of nitrogen. This furnishes an artificially prepared nitrogenous material which may be of fertilizer value and similar to cottonseed meal, tankage, and blood but of higher nitrogen content.

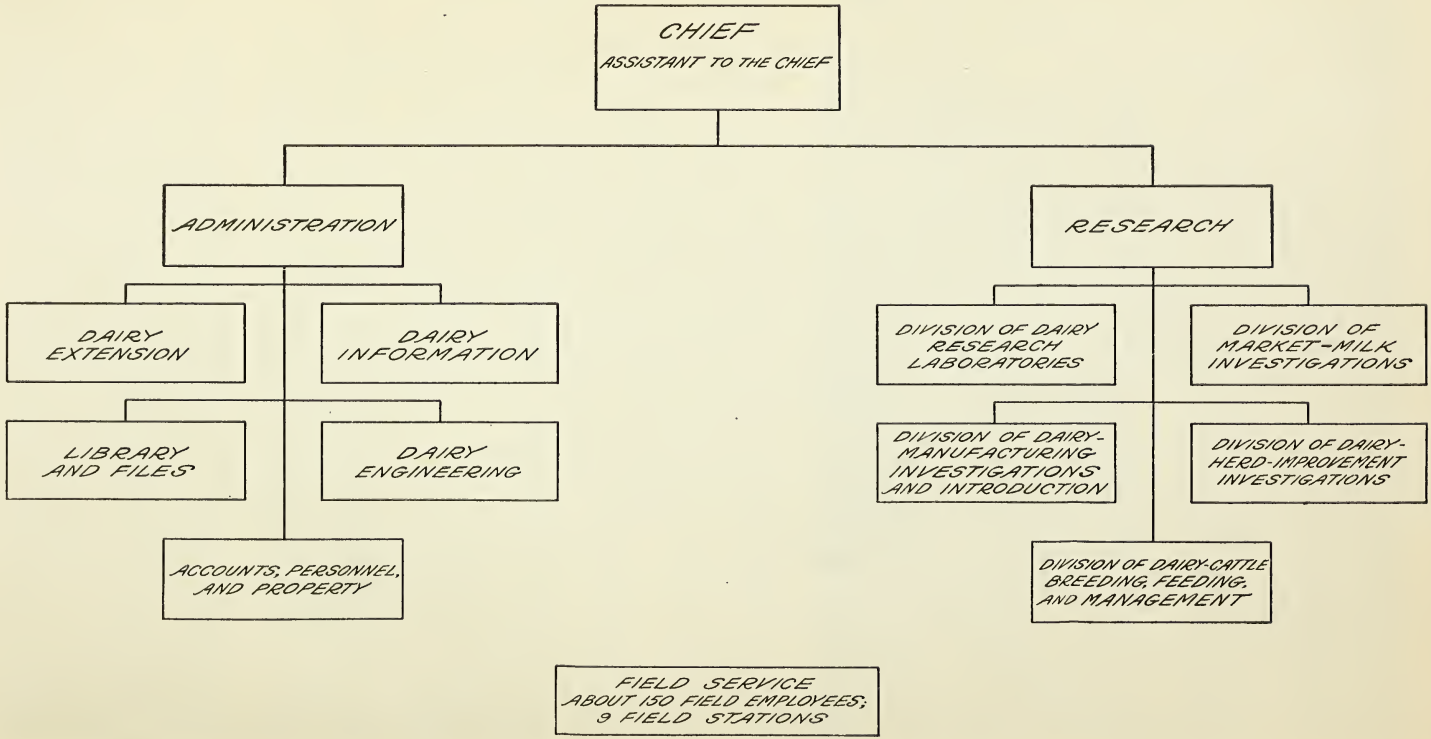
A detailed study has been made by the Bureau of the chemical constitution and composition of the commercial varieties of domestic phosphate rock. This work has contributed to the successful development of a commercial process for recovering high-grade phosphate rock from low-grade and waste materials, which will double the life of our phosphate resources. Also, as a result of this work, an economical method has been devised for the treatment of phosphate rock, whereby the phosphoric acid is converted into a form slightly soluble in water but readily available to plants, and the fluorine content of the rock is completely recovered in the form of marketable products. Investigations on the smelting of phosphate rock in a fuel-fired blast furnace for the production of liquid phosphoric acid have been carried on actively in connection with the use of the same equipment for the recovery of potash from its insoluble minerals.

Recent progress in potash investigations by the Bureau of Chemistry and Soils, conducted with the objective of promoting the development of a domestic potash industry to terminate American dependence on a foreign monopoly, may be measured, in some degree at least by the progress registered within that industry, founded on and fostered since its inception by the Bureau's work. Two additional potash resources have recently been brought under development and plant capacities have been increased 100 percent, while the ratio of domestic production to importations has increased from 19

percent to 30 percent. New processes applicable to additional potash raw materials promise a continuation of this expansion to meet agriculture's demand for potash supplied with lowered distribution costs.

The development of new methods of manufacture and of methods for improving the physical properties of fertilizers have made possible the preparation of concentrated mixtures that are equal in every respect to the best types of low-analysis mixtures. Mixtures of this kind not only cost less to handle and ship but also cost less to produce per unit of plant food than lower-grade mixtures. The improvements that have been made in the physical properties of fertilizers consist in subjecting them to a granulating treatment in the process of manufacture, in ammoniating the acid components of the mixture, and in determining the combinations of components that will exhibit a minimum tendency to absorb moisture from the air. These improvements in the physical properties of fertilizers have contributed to a marked increase in their efficiency by increasing the uniformity with which they can be distributed in the field. Further increases in fertilizer efficiency have also been made by determining the proper placement of the fertilizer with respect to the seed, by developing methods for reducing the tendency of fertilizers to burn the crop and by showing how fertilizer mixtures may be prepared that will not increase the acidity of the soil to which they are applied.

BUREAU OF DAIRY INDUSTRY



BUREAU OF DAIRY INDUSTRY

The Bureau of Dairy Industry is primarily a research organization. It carries on scientific research in the genetics and breeding, feeding, and management of dairy cattle; in the manufacture of milk and cream into butter and cheese and other products; in the utilization of milk byproducts in manufactures and as human and animal food; in the economical production of high-quality milk and cream; and in the efficiency of operation of milk plants. The Bureau helps the dairy industry to apply improved methods suggested by research and by investigations of commercial practice. Briefly, the Bureau strives to aid in raising the level of prosperity in the dairy producing, manufacturing, and distributing industries, and to see that the consumer gets wholesome products of high quality.

The Bureau of Dairy Industry was organized July 1, 1924. Previously (1895 to 1924) dairy research and service in the Department had been done by the Dairy Division of the Bureau of Animal Industry, which became a part of the new Bureau.

The work of the Bureau of Dairy Industry is divided among five divisions: (1) The Division of Dairy Research Laboratories; (2) the Division of Dairy Cattle Breeding, Feeding, and Management; (3) the Division of Dairy Herd Improvement Investigations; (4) the Division of Market Milk Investigations; and (5) the Division of Dairy Manufacturing Investigations and Introduction.

THE RESEARCH LABORATORIES

The Bureau's principal chemical and bacteriological laboratories are in Washington. Nutrition research is done in laboratories and in a special nutrition barn at the United States Dairy Experiment Station at Beltsville, Md., just a few miles northeast of Washington. In the Washington laboratories the Division has small-scale equipment for manufacturing all kinds of dairy products, so that the commercial possibilities of research results may be indicated. At Grove City, Pa., in a farmers' cooperative creamery known as the "Grove City Creamery", the Division maintains a research laboratory, at which, under a mutual arrangement, the results of the Bureau's research work are tested under commercial factory conditions. The Grove City Creamery was established in 1915, with the aid of the Dairy Division of the Bureau of Animal Industry.

The Division of Dairy Research Laboratories studies the nutrition of dairy cows and the physiological problems of milk secretion. This work involves research into the protein requirements of dairy cows and into the mechanism by which the nutritional elements of feed are converted into the constituents of milk. It includes study of the mineral requirements of the cow for high and efficient milk production, and of the form in which these requirements are best supplied. The vitamin values of various feedstuffs and the relation

of the vitamin content of the feed to the metabolism of the mineral elements of the ration are studied.

More knowledge of the chemistry and bacteriology of milk is greatly needed in the dairy industry and by distributors and consumers of dairy products. Accordingly the research laboratories of the Bureau attack such problems as: What are the factors that control the stability of the suspension of protein in milk? What is the action of acids and rennin in changing the relationships of the various constituents of milk? What change takes place in the oxygen tension in milk due to the growth of bacteria? What factors control the growth and death rates of bacteria? What chemical changes are brought about in milk by the growth of bacteria?

The physicochemical laws involved in making ice cream of the most desirable texture and flavor are not well understood. The ice-cream laboratory studies the influence of the various ingredients, and of the treatment of the ingredients on the viscosity and plasticity of the ice-cream mixture, and the influence of the viscosity and plasticity of the mixture upon the "over-run" in the freezing process. Another problem under investigation is the control of the separation of sugar from the ice-cream mass and the resulting formation of "sand" (sugar crystals) in the ice cream. Still another is how to improve the flavor of the product by treating the constituents of the mixture before freezing.

Condensed milk and dried skim milk are becoming more important in the list of dairy products. The Bureau's research work on these products covers processes for concentrating milk in the form of sweetened condensed milk, sterilized evaporated milk, and dried milk. What causes the thickening of sweetened milk in storage? What causes crystals to form in evaporated milk? What causes evaporated milk to curdle in the sterilizing process? What causes the oxidation of fat in a number of dairy products. and thus impairs their keeping quality, and how can this oxidation be controlled? Under what conditions will dried skim milk keep best? What methods of processing and manufacture will produce a particular dairy product best suited to a specific use? Mere mention of these problems suggests the diversity of the Bureau's research.

Cheese has been imported into the United States in recent years to the amount of about 75,000,000 pounds a year. The manufacture of this cheese in this country would provide a market for the output of about 150,000 good dairy cows. The cheese is imported mainly because of its high quality. Nearly all the foreign-type cheese made in this country is sold at distinctly lower prices than the imported article. How the American dairy industry may produce foreign-type cheese that will hold its own in the market is a major subject of research in the Bureau.

The economic utilization of milk byproducts receives much attention. In the manufacture of butter and cheese, vast quantities of skim milk, buttermilk, and whey are byproducts. In a year's volume of these byproducts there are about 900,000,000 pounds of protein and about 1,400,000,000 pounds of milk sugar. How these byproducts may be utilized to economic advantage is a problem of the first magnitude which the research laboratories are trying to solve.

BREEDING, FEEDING, AND MANAGEMENT INVESTIGATIONS

Breeding, feeding, and management are the main stones in the foundation of the dairy industry. These are the chief factors in its production economics. They largely determine what the consumer pays and what the producer earns.

Breeding experiments are carried on by the Division of Dairy Cattle Breeding, Feeding, and Management with herds at the United States Dairy Experiment Station at Beltsville, Md., and at seven United States dairy field stations located at Huntley, Mont.; Mandan, N.Dak.; Woodward, Okla.; Jeanerette, La.; Columbia, S.C.; Lewisburg, Tenn.; and Hannibal, Mo. These field stations have conditions that are fairly representative of the particular areas in which they are situated. The Huntley and Mandan stations are on the northern Great Plains; the Woodward is on the southern Great Plains; the Jeanerette in the rice and sugar region; the Columbia in the sand-hill belt of the southern Atlantic coastal plain; and the Lewisburg station in the midst of the general-farming region of the central South. Some of the stations are conducted in cooperation with the State colleges of agriculture.

Breeding done at these stations is designed to develop dairy strains pure in inheritance for high production of milk and butterfat. The method involves the continuous use of sires that have demonstrated, through the performance of their daughters as compared with that of the dams of the daughters, that they can and do transmit to their offspring the genetic factors for high production. Only bulls of proved worth in transmitting the genetic factors for high milk production are used.

Some breeding work is done to compare linebreeding with outbreeding, and inbreeding with outbreeding, and to test extreme outcrossing when individuals of families not related within the breed are mated. Experiments in feeding and management are carried on at the same time.

A uniform system of feeding and management is practiced when the animals are being tested for production, and the production records, besides measuring the producing capacity of the cow, yield information valuable in research on feeding. Experiments to compare the relative merits of milking 2, 3, and 4 times a day, in feeding different kinds and grades of hay, and in pasture management, yield important data.

At the Beltsville station the fertility of both male and female dairy cattle is studied. The official records published by various dairy breed associations are consulted for facts which may throw light on heredity, and also to locate proved bulls.

A comprehensive program of research into the relation between body comformation and the cow's capacity for production is under way. Cows no longer useful for other experimental purposes are slaughtered, and their internal organs are weighed and measured. The post-mortem data are studied in relation to external measurements made at regular intervals during the life of the animal. The purpose is to find out what relationship there is between the external measurements and appearance of a cow and the size of her internal organs, and what relation there is between these elements and her producing capacity. By this research the Bureau expects to deter-

mine whether a deep and wide chest means great lung and heart capacity; whether large lungs and heart are necessary for high production; whether there is a definite relation between the size, depth, and circumference of the paunch and the length and capacity of the digestive tract; and whether great digestive capacity is necessary for high production. The judging of dairy cattle is based largely on theory that may or may not be well founded. It is the purpose of this work to bring out facts upon which to base the judging of dairy cattle. Nineteen State colleges of agriculture are cooperating in this project.

DAIRY HERD-IMPROVEMENT INVESTIGATIONS

The Division of Dairy Herd Improvement Investigations tabulates and studies the yearly individual cow records of the cows on test in dairy herd-improvement associations. These records are especially valuable for investigational purposes, because they are made under normal farm conditions and because there are so many of them.

The dairy herd-improvement association is an organization of dairymen who employ cooperatively a man to test their cows for economical production of milk and butterfat. The associations have a twofold purpose—the testing of cows and the proving of bulls. On January 1, 1933, there were 881 dairy herd-improvement associations in active operation in 44 States. In these associations there are, at the present time, 358,501 cows on test for production of milk and butterfat. Through a cooperative arrangement with the States, the Bureau of Dairy Industry supplies printed blank forms for keeping records, and receives in return copies of the yearly individual cow records for investigational purposes.

These records furnish data for the study of many dairy problems. They make possible the study of such subjects as the relation of butterfat production to income returned over the cost of feed, the effect of season of freshening upon production and income, and the influence of size of cow upon production and economy of production. About 20 subjects are now being studied by the Bureau and more than 60 have been outlined for future work.

The records made by the cows on test in dairy herd-improvement associations in 1932 showed an average production of 7,858 pounds of milk containing 310 pounds of butterfat, or a production approximately 83 percent above the average for all the milch cows in the United States. The records of dams and daughters show the ability of sires to transmit high production to their offspring, and furnish the information that is necessary for intelligent and constructive breeding through the use of meritorious proved bulls.

The primary purpose of these herd-improvement investigations is to measure progress in herd improvement and to point out the practices that lead to such improvement. Though much has already been accomplished through the analyses of data, the work is only begun. Although more than 358,000 cows are now on test in dairy herd-improvement associations, the number should be much larger. As the number of cows on test increases more and more of the production problems of the dairy farmer can be studied and greater progress can be made in bringing about economy of production in dairy herds everywhere.

MARKET-MILK INVESTIGATIONS

The Bureau does research and service work to improve the quality of dairy products, as well as to increase production per cow. Dairy producers as a group could increase their aggregate income by millions of dollars a year by taking the precautions necessary to attain and maintain high quality in the product. Sour or off-flavored milk and cream usually cannot be marketed as advantageously as high-quality sweet products. If the dairyman, who offers such products, finds a market, the price he gets is low compared with what he could get if he offered high-quality products. The consumption of dairy products might be greatly increased. The per capita consumption of milk in this country is much lower than in a number of other civilized nations. Raising still higher the general level of quality of dairy products is urged by the Bureau as a powerful means of stimulating consumption.

The Bureau carries on dairy-sanitation investigations, to develop better methods for handling fluid milk and cream. Its quality-improvement work relates to the sanitary treatment of utensils, the care of milking equipment, the cooling of milk and cream to prevent the growth of bacteria in the product, the care of milk and cream in transit, efficiency in pasteurization, and sanitation in city milk plants. The Bureau assists State and local authorities in formulating proposed legislation and ordinances for sanitary safeguarding of the milk and cream supply, and in establishing systems of inspection.

The problems of the city milk distributor are studied to develop means of reducing the cost of processing and delivering milk. Very few foodstuffs are delivered to the consumer as quickly, and in as clean a manner, as milk and cream, but there is still room for improvement. Important studies are under way regarding the creaming property of milk, the whipping quality of cream, the viscosity of cream, and the factors which affect the flavor and odor of milk.

DAIRY-MANUFACTURING INVESTIGATIONS

One of the main functions of the Division of Dairy Manufacturing Investigations and Introduction is to maintain practical contact between the research laboratories and the dairy products and dairy byproducts factories of the United States; to study the needs of factories for better methods and processes; to take up these needs with the research laboratories, and then, when the research scientists have found and demonstrated better methods and processes, to help put the research results into commercial practice.

The factories' main current products—butter and cheese—are accompanied by enormous quantities of byproducts, skim milk, buttermilk, and whey, which are capable of yielding great quantities of valuable products—casein, lactose (milk sugar) acids, etc. These byproduct materials are now largely wasted or are utilized to poor economic advantage as compared with their possibilities. Science must find how these byproducts can contribute to the prosperity of the dairy industry. This is one of the biggest tasks in the dairy industry, and consequently stands as an important aspect of the Bureau's work.

Another important feature of this Division's work is its investigations to determine what factors affect the quality of manufactured dairy products at all stages in the channels of commerce, and to devise ways and means for attaining and maintaining high quality in these products wherever they may be, up to the point of final consumption.

It studies the limit of acidity of cream for the manufacture of butter in relation to the keeping quality of the butter in storage; the quality and shrinkage of butter in storage in relation to the length of time in storage; problems in the transportation of cream from the farm to the creamery; problems in the handling of cream and milk in butter- and cheese-manufacturing plants, and the relation between factory arrangement and efficiency. It investigates problems in the operation of creameries and cheese factories which are especially related to the quality of the butter and cheese made, and cooperates with factory managements and public officials in effecting improvements.

This Division introduces into Swiss-cheese factories a new method, known as the "culture method." Use of this method enables the manufacturer to make Swiss cheese of higher quality than that made in this country in the old way.

In the introduction of the best known methods of making butter and Cheddar cheese, the Bureau is assisting many factories to improve their product and effect economies in manufacture. In communities where creameries and cheese factories are comparatively new enterprises, Bureau experts visit the plants and help to work out better methods.

Methods developed in the Bureau's research laboratories for making concentrated sour skim milk have been introduced in about 20 plants which are now making this product. About 40 plants, located in various parts of the country, used approximately 76,000,000 pounds of skim milk in 1930.

The sanitary inspection of factories making renovated butter is under the supervision of this Division. At the beginning of 1933 five such factories in the United States were producing about 1,100,000 pounds of renovated butter per year as compared to 3,000,000 pounds in 1929. They must maintain strict sanitation, and their manufacturing must meet the Bureau's requirements.

One of the important features of the Bureau's service work at present is the introduction into casein factories of the Bureau's method of making casein, known as the grain-curd method. This method yields a product equal to the best foreign product. Casein experts of the Bureau are visiting casein plants all over the country, showing them how to manufacture under the Bureau method.

EXTENSION AND INFORMATIONAL WORK

The full value of the Bureau's work is realized only when the results are applied in farm and commercial practice. So that its research findings may be applied effectively and without delay, the Bureau and the Office of Cooperative Extension Work of the Department have dairy subject matter extension specialists in the four main geographic regions of the country. These specialists work out, with

the State directors of extension work and with State dairy extension specialists all over the country, practical ways and means for getting research results into practice. Through the Office of Information of the Department, the Bureau issues information to the dairy industry and to the general public in Government publications, articles in the press, and radio broadcasts; and through the Extension Service dairy information is disseminated by means of exhibits and motion pictures.

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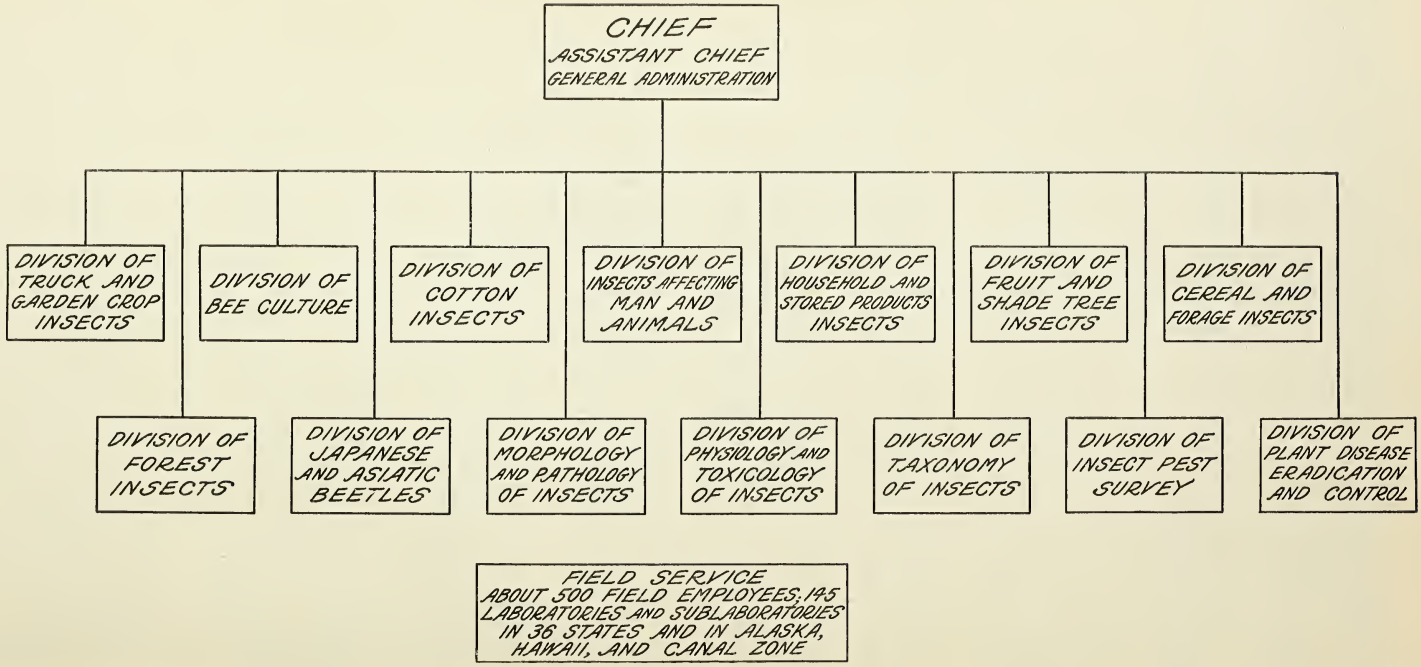
BUREAU OF ENTOMOLOGY


CHIEF
ASSISTANT CHIEF
GENERAL ADMINISTRATION
DIVISION OF TRUCK AND GARDEN CROP INSECTS
DIVISION OF BEE CULTURE
DIVISION OF COTTON INSECTS
DIVISION OF INSECTS AFFECTING MAN AND ANIMALS
DIVISION OF HOUSEHOLD AND STORED PRODUCTS INSECTS
DIVISION OF FRUIT AND SHADE TREE INSECTS
DIVISION OF CEREAL AND FORAGE INSECTS
DIVISION OF FOREST INSECTS
DIVISION OF JAPANESE AND ASIATIC BEETLES
DIVISION OF MORPHOLOGY AND PATHOLOGY OF INSECTS
DIVISION OF PHYSIOLOGY AND TOXICOLOGY OF INSECTS
DIVISION OF TAXONOMY OF INSECTS
DIVISION OF INSECT PEST SURVEY
DIVISION OF PLANT DISEASE ERADICATION AND CONTROL
FIELD SERVICE
ABOUT 500 FIELD EMPLOYEES; 195 LABORATORIES AND SUBLABORATORIES IN 36 STATES AND IN ALASKA, HAWAII, AND CANAL ZONE

BUREAU OF ENTOMOLOGY

One of the earliest activities connected with the alleviation of agricultural conditions had to do with methods of controlling insects. The need of protecting crops from damages caused by insect pests has long been recognized. The growth of economic entomology in the United States has been phenomenal and largely led by the activities of the Federal Government. Federal appropriations for work on insects have increased from an annual budget in 1878 of $5,000, to approximately $2,300,000 for the fiscal year 1930.

The forerunner of the present Bureau of Entomology was the appointment of an entomologist in 1854 in the Division of Agriculture of the Patent Office to collect statistics and other information on seeds, fruits, and insects in the United States. The great outbreaks of migratory locusts in the West in 1874, 1875, and 1876 led to the appointment by Congress in 1877 of a special Entomological Commission to study this pest. In 1883 the Division of Entomology was established with a personnel of 3 or 4 men. The present Bureau of Entomology has a personnel of some 580 employees, including approximately 420 trained specialists.

Most of the problems of insect control have been brought about by the rapid expansion of agriculture. As new lands were brought under cultivation many native insects turned their attention to cultivated crops, on which they developed in enormous numbers. On the other hand, many of our worst insect pests have been brought to our shores from foreign countries, some of them coming in with the early settlers, others following rather in more or less regular succession until comparatively recently (1912) when legislation was enacted which authorized the promulgation of quarantines regulating the entry of plants and plant products. The country has had a succession of important insect problems, beginning with the ravages of the Rocky Mountain locust during the seventies. The Colorado potato beetle became troublesome about the same time, and the cotton caterpillar in the South a few years later. Damage was done by the codling moth to apples; by the Hessian fly and the Angoumois grain moth to the wheat crop; by the chinch bug to the corn crop. The advent of the San Jose scale into eastern orchards about 1890 aroused grave fears for the welfare of our fruit-growing industry. This insect caused many of the States to pass legislation to restrict its spread.

ENTOMOLOGY STIMULATED BY INVASION OF PESTS

Notably increased prominence was given to entomological work when the cotton bollweevil invaded Texas from Mexico about 1892. Entomology had been stimulated somewhat earlier by the introduction from Europe of the gypsy and brown-tail moths into Massachusetts. The discovery during the late nineties of the transmission

of yellow fever by mosquitoes was an additional incentive to entomological effort. More recently certain introduced pests, including the alfalfa weevil, the European corn borer, the Japanese beetle, the oriental fruit moth, and the pink bollworm, have focused public attention increasingly on insects in their relation to man's welfare. The great value of the crops menaced and the large appropriations made for the control of certain pests have impressed the significance of entomological work not only on farmers but on the general public. With the rapid development of agriculture there has been a correspondingly larger opportunity for insect damage, and at present it is conservatively estimated that the losses due to insects are not less than $2,000,000,000 per year.

FUNCTIONS OF THE BUREAU

When the entomological work was first established its functions were primarily to develop methods of control of various insect pests in order that such information might be made available to farmers and others in interest. Following the enactment of the Plant Quarantine Act of 1912 and the undertaking by the Federal Government of the control of certain important pests and the enforcement of regulations to prevent their spread, the administrative direction of this work on certain of these important insect pests was assigned to the Bureau of Entomology. Beginning with the fiscal year 1928 the Department's work, insofar as it pertained to the regulatory activities dealing with the protection of plants or plant products, was reorganized and all those activities which had to deal with the enforcement of regulations for the control of introduced pests were transferred to the newly established Plant Quarantine and Control Administration. The duties of the Bureau of Entomology were restricted to those undertaken at the time of its establishment, namely, research concerning insects and their economic relations. This task includes the study of insects injurious to crops and crop products, development of methods for their eradication or control, the study of those insects affecting the health of man and livestock, including those infesting human habitations or injurious to our industries. It also involves the study of insects which may be beneficial, both those forming the basis of certain industries, as the honeybee, and those which prey on others and thus aid in controlling pests which attack cultivated crops or forests. The investigations of the Bureau are carried on both independently and in cooperation with other branches of the Federal Government or with State, county, and municipal agencies as well as with agricultural and other organizations and individuals. Certain phases of the work are also carried on in cooperation with the specialists of foreign governments. The research work is carried out largely at field stations or laboratories. The number of these stations varies somewhat from year to year. There are at present about 100 laboratories, some of them semipermanent and equipped for thorough-going research. The aim is to build up a corps of entomologists capable of furnishing information on all insects that affect mankind. The investigational work of the Bureau is carried out in the following 12 divisions.

FRUIT AND SHADE-TREE INSECTS

The Division of Fruit and Shade Tree Insects is concerned with investigations of insects affecting woody horticultural plants, including fruit, nut, shade, and ornamental trees and shrubs. It also carries on investigations on insects injurious to grapes and certain other small fruits, such as blueberries and cranberries. Some of the more important insects which are now under investigation are the codling moth, oriental fruit moth, peach curculio, grape berry moth, citrus red scale, citrus rust mite, and various fruit flies which attack citrus and other subtropical fruits. The investigations which have been carried on on these and the numerous other pests injurious to fruit and shade trees make it possible to recommend effective methods of control, some of the more outstanding accomplishments being the recent development of the treatment of the peach borer by the use of paradichlorobenzene, and the control of the blueberry maggot by the use of calcium arsenate dust.

JAPANESE AND ASIATIC BEETLE INVESTIGATIONS

The Division of Japanese and Asiatic Beetles concerns primarily the investigation of the four pests which have been comparatively recently introduced into this country and occur in a limited portion of the northeastern part of the United States, the most important and more widely distributed of which is the Japanese beetle. This work is headquartered in Moorestown, N.J., and sublaboratories are maintained at other places within the infested areas, as well as in Japan. Investigations deal with the development of methods of control of these beetles by natural and artificial means. They involve the introduction of natural enemies from the native habitat. Methods of protecting foliage from the ravages of the adult Japanese beetle have been developed, resulting in the modification of lead arsenate by treating it with an oleate so it would not be repellent to the beetle. Rather effective methods have been developed for the control of the grubs in soil. The results of these investigations have also proved useful in controlling other insects which have somewhat similar habits.

DIVISION OF TRUCK CROP AND GARDEN INSECTS

The Division of Truck Crop and Garden Insects is concerned with the study of insects and the development of means of control of those forms which are injurious to truck and garden crops, including vegetables, bulbous plants, potted ornamentals, all types of plants grown under glass, and such small fruits as strawberries, raspberries, and blackberries. The work on insects injurious to sugar beets and tobacco also is carried on in this Division, as well as special studies on the European earwig, pests of mushrooms, and miscellaneous wireworms and white grubs which attack various kinds of vegetables. Some of the more important insects which are studied under this head are the Mexican bean beetle, sugar-beat leafhopper, tobacco hornworms, sweetpotato weevil, and scores of other insects common to vegetable and flower gardens. An interesting phase of the work

is that which is done on the sugar-beet leafhopper, and includes an intimate study of the insect in its native areas which will permit the issuance of reliable predictions as to the probable abundance, and hence destructiveness, of this pest in the cultivated areas. These predictions have enabled the growers to plan their plantings intelligently.

FOREST-INSECT INVESTIGATIONS

The Division of Forest Insects is concerned with research on insects injurious to forest trees and crude forest products, the determination of methods of control of such pests, the direction of campaigns against serious outbreaks over large forested areas, and with cooperation with Federal and State officials and private owners in carrying on campaigns for their control. It also includes investigations on important introduced moths, such as the gypsy moth, the brown-tail moth, the satin moth, and the European pine shoot moth, and the study of their habits and development of methods of their control by both artificial and natural means, the latter involving the importation from foreign countries of parasitic and predacious enemies. The native insects which receive the most attention are those tree-killing bark beetles of the genus *Dendroctonus* which have caused the destruction of large areas of valuable pine timber not only in the mountains of the West but also in the southern Appalachian region.

CEREAL AND FORAGE INSECTS

The Division of Cereal and Forage Insects is concerned with investigations leading to the development of effective and economical means of controlling the large number of insects which affect cereal and forage crops, including sugarcane. The activities include, in addition to the actual insect studies, experimentation leading to control by cultural practices, the use of machinery, or other methods. The investigational work on the European corn borer and the sugarcane moth borer falls in this Division. In addition to carrying out studies on the control of these pests by artificial or cultural methods, an effort has been made to reduce their numbers by importing beneficial insects from foreign countries. This Division is also concerned with investigations on grasshoppers, the alfalfa weevil, and the Hessian fly. It has recently devised a method whereby the poisoned-bran bait used in the control of grasshoppers can be more effectively and economically prepared by the milling interests.

COTTON INSECTS

The investigations of insects injurious to cotton and the development of methods of their control, either by direct or indirect means, come within the Division of Cotton Insects. Some of the principal pests which are being studied are the cotton bollweevil, pink bollworm, cotton leaf worm, cotton leaf perforator, and flea hopper. The investigations conducted by the members of this Division have demonstrated the effectiveness of calcium arsenate dust in bollweevil control. The investigations on the pink bollworm are carried on in

cooperation with the State of Texas in the limited portion of that State which has become infested. Some studies are also carried on in Mexico in cooperation with the Mexican Government. Investigations on the dry-land form of the bollweevil known as the "Thurberia weevil", which is confined to high parts of Arizona, also fall within this division.

INSECTS AFFECTING MAN AND ANIMALS

Insects affecting man and animals are studied by a division which brings together in the Bureau all investigations relating to such pests as house flies, mosquitoes, body lice, and chiggers affecting man, and cattle grubs, screw worms, stable flies, and chicken lice affecting animals. Particular attention is given to mosquitoes and sand flies, and to gnats believed to be concerned in the dissemination of pink eye of man. Among livestock insects the cattle grub, the screw worm, and certain mites and insect pests of fowls receive particular attention. Recent experiments conducted by members of this Division, in cooperation with a medical research worker, have proved that the tropical rat mite not only causes a dermatitis of man but that it is capable of transmitting endemic typhus. This is a discovery of outstanding importance, as the disease is wide-spread in this country.

HOUSEHOLD AND STORED-PRODUCT INSECTS

The Division of Stored Product Insects is concerned with investigations on the habits and development of control measures for the various insects attacking agricultural and manufactured products in storage, as well as the control of those insects which are household pests. The activities include investigations on insects attacking grain, grain products, dried fruits, all foods and drugs in storage, stored and manufactured tobacco, and finished wood products. It also involves the study of those insects which infest manufacturing plants and warehouses—those which injure hides, clothing, carpets, upholstery, etc. The studies which have been conducted have led to the development of effective methods of control of such pests as the flour moth, clothes moth, the various pests attacking dried figs and raisins, etc. Important studies are now being carried on to determine methods of controlling certain insects recently known to attack tobacco in storage.

DIVISION OF TAXONOMY

The Division of Taxonomy is concerned with the identification, classification, and description of insects both in the adult and immature stages. These activities are of a fundamental nature and involve exact and continuing research. The first step in any entomological investigation is to know the insect concerned. The identifications which are made and supplied to specialists conducting studies of the life history and development of means of control of important economic pests enable them to record their investigations on the species concerned and thus make them of permanent value. This work is therefore essential to all other activities of the Bureau.

INSECT PEST SURVEY

The insect pest survey is concerned with collecting, recording, analyzing, and maintaining permanent records on insect abundance and damage. One of the important activities of this Division is the publication of a monthly bulletin of current insect conditions based on information supplied by the cooperating entomologists in all parts of the United States as well as in Canada, Mexico, and certain other foreign countries.

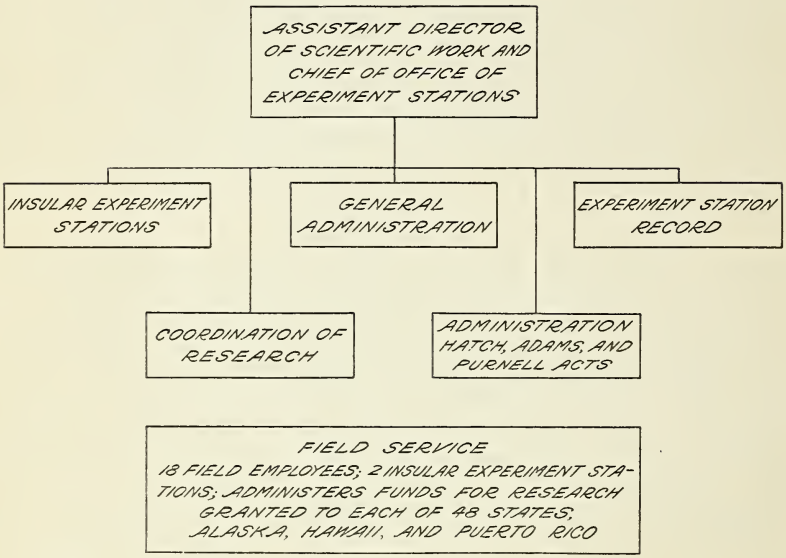
DIVISION OF PHYSIOLOGY AND TOXICOLOGY

The recently organized Division of Physiology and Toxicology is concerned with fundamental research on physiology and toxicology of insects. The purpose is to determine basic facts as to the physiological effect of poisons on major insect groups, to investigate vital processes of the insects, and to study their behavior in known environmental conditions in order to give a basis for the determination of the results of experiments on attractants, repellents, and baits. One of the important activities with which this Division is concerned is the determining of the toxicity of various insecticidal materials. Much of this work is carried on in cooperation with the Bureau of Chemistry and Soils.

BEE CULTURE

The activities carried on in the Division of Bee Culture comprise studies on the habits and management of bees to make their production of honey and wax more profitable and to facilitate pollination of fruit and forage crops by the use of honeybees. Headquarters for this work are at Somerset, Md., and investigations concerning particular regions are carried on at field laboratories. The more important work is divided into two main heads. One of these is primarily of a biological nature and is concerned with the various responses of the honeybee to natural and artificial conditions. The other main type deals with investigations on general problems of apiary management and on honey and its care in honey houses and preparation for market.

OFFICE OF EXPERIMENT STATIONS


ASSISTANT DIRECTOR OF SCIENTIFIC WORK AND CHIEF OF OFFICE OF EXPERIMENT STATIONS
INSULAR EXPERIMENT STATIONS
GENERAL ADMINISTRATION
EXPERIMENT STATION RECORD
COORDINATION OF RESEARCH
ADMINISTRATION HATCH, ADAMS, AND PURNELL ACTS
FIELD SERVICE
18 FIELD EMPLOYEES; 2 INSULAR EXPERIMENT STATIONS; ADMINISTERS FUNDS FOR RESEARCH GRANTED TO EACH OF 48 STATES; ALASKA, HAWAII, AND PUERTO RICO

OFFICE OF EXPERIMENT STATIONS

The Office of Experiment Stations represents the Department in the administration of the Hatch, Adams, and Purnell Acts, which provide $4,381,000 ($90,000 to each State, $15,000 to Alaska, $26,000 to Hawaii, and $20,000 to Puerto Rico) in the fiscal year 1934 for the support of the State and Territorial agricultural experiment stations. It also supervises the use of the funds (amounting to $78,130 for the fiscal year 1934) appropriated by Congress for the maintenance of agricultural experiment stations in Hawaii and Puerto Rico. The Office is required to ascertain whether the funds are used in accordance with the acts authorizing them, to aid in coordinating the work of the Department with that of the stations, to give such advice and assistance as will best promote the purposes of the Federal acts, and to report annually on the work and expenditures of the stations.

RELATIONS WITH THE EXPERIMENT STATIONS

In addition to its administrative duties under the Federal acts the Office has advisory relations with the experiment stations with regard to all of their activities, which now involve a total annual expenditure, including the Federal funds, of about $16,000,000. In this capacity the Office deals with questions of organization and administration, personnel, equipment, lines of work, formulation and coordination of projects, and cooperation. Representatives of the Office visit each of the State experiment stations annually to confer with their officers, to examine and report upon their work, and to aid the stations in organizing and developing their research. The Office keeps the stations informed as to the progress of agricultural research through Experiment Station Record and supplies them with other essential information through publications and in other ways.

Records are kept of all research projects of the stations, now numbering some 7,000, particularly those supported by Federal funds and those carried on in cooperation with the Department and by groups of stations. Projects supported by the Adams and Purnell funds are examined and approved by the Office before they are undertaken by the stations.

EXPERIMENT STATION RECORD

In Experiment Station Record, published in two annual volumes of about 1,000 pages each, with detailed author and subject index, the Office gives a current technical review of the publications of the Department of Agriculture and of the agricultural experiment stations, and of other scientific literature pertaining to agriculture and home economics, with editorials and notes on developments in

agricultural research and the progress of institutions for agricultural education and research throughout the world. In addition to the Record, the Office prepares and publishes information regarding personnel, legislation, publications, and other matters relating to the organization and work of the experiment stations.

INSULAR EXPERIMENT STATIONS

The Division of Insular Stations of the Office has direct charge of supervision of the use of funds appropriated by Congress for the maintenance of agricultural experiment stations in Hawaii and Puerto Rico. It prepares budgetary estimates for the operation and general support of these stations; aids in maintaining a staff of efficient workers at each station; advises as to lines of work and methods; has charge of the publication of their bulletins and reports; and assists in outlining policies for the improvement of agriculture in the regions which they represent; and aids in coordinating the work of these stations with the work of the insular agencies and with other work of the Department of Agriculture.

Territorial experiment stations in Alaska, Hawaii, and Puerto Rico receive Federal funds, which are administered by the Office of Experiment Stations.

By act of Congress approved May 16, 1928, the benefits of the Hatch and supplementary acts were extended to Hawaii, and the experimental work in the Territory was consolidated under a plan approved by the Secretary of Agriculture and is now conducted jointly by the Department and the University of Hawaii.

By act of Congress approved February 23, 1929, the benefits of the Hatch Act were extended to the Territory of Alaska, provided—

> that no appropriation shall be made under this act until annually estimated as to funds and amounts by the Secretary of Agriculture; the estimates to be based upon his determination of the ability of the Territory of Alaska to make effective use of the funds.

In accordance with this act a new station was organized in connection with the Alaska Agricultural College and School of Mines. The experiment station operated by the Department since 1907 at Fairbanks was merged with the new organization in 1931 and the station operated by the Department at Matanuska was transferred to and merged with the new organization in 1932. The Department stations at Sitka and Kodiak were closed and the work discontinued in 1932.

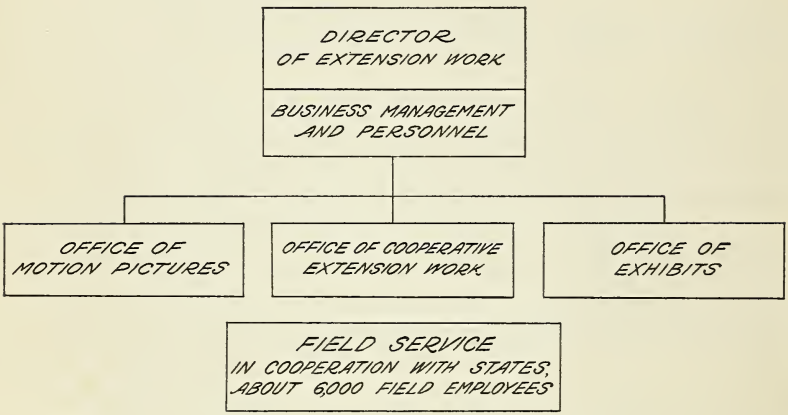
An act of Congress approved March 4, 1931, provides for coordination of agricultural experiment station work in Puerto Rico on cooperative plans approved by the Secretary of Agriculture, and extends the benefits of the Hatch and supplementary acts to the Territory of Puerto Rico.

HISTORY OF THE OFFICE

The Office of Experiment Stations was established October 1, 1888, to represent the Department of Agriculture in its relations with the State agricultural experiment stations recently organized under the Hatch Act of 1887. In 1915 it became a part of the newly created States Relations Service, but again became a separate unit on the

abolition of the States Relations Service in 1923. Its duties were enlarged in 1906 by the passage of the Adams Act, which provided for "an increased annual appropriation for agricultural experiment stations and regulating the expenditures thereof"; by the passage in 1925 of the Purnell Act, which provided increased funds for work at the experiment stations in agricultural economics, rural sociology, and home economics, as well as in the technic of production; and by legislation extending the benefits of the Hatch and supplementary acts to Alaska, Hawaii, and Puerto Rico.

EXTENSION SERVICE


DIRECTOR OF EXTENSION WORK
BUSINESS MANAGEMENT AND PERSONNEL
OFFICE OF MOTION PICTURES
OFFICE OF COOPERATIVE EXTENSION WORK
OFFICE OF EXHIBITS
FIELD SERVICE
IN COOPERATION WITH STATES; ABOUT 6,000 FIELD EMPLOYEES

EXTENSION SERVICE

The Extension Service of the Department of Agriculture aids in making available the results of research and investigation in agriculture and home economics to those who can put the information into practice. The Service consists of the Office of the Director, the Office of Cooperative Extension Work, the Office of Exhibits, and the Office of Motion Pictures.

The Office of the Director, which was created by Congress and began its work in 1923,[2] coordinates the extension activities of the bureaus of the Department and of the State agricultural colleges, and supervises the administration of the personnel and funds of the Extension Service.

The Office of Cooperative Extension Work represents the Department in the conduct of cooperative extension work in agriculture and home economics by the State agricultural colleges and the Department under the Smith-Lever and Capper-Ketcham Acts of Congress. The 48 States and the Territories of Hawaii and Alaska each have a State director of extension who represents jointly the Department and the State agricultural college in the administration of extension work.

ORGANIZATION WITHIN THE STATES

In each State the organization consists of a State administrative and supervisory staff with headquarters in most cases at the State agricultural college, and county extension workers who have their offices usually in the county seats. County agricultural extension agents are employed in 2,200 agricultural counties and home demonstration agents in 1,250 counties. Work with farm boys and girls is carried on in counties having extension workers by the agricultural and home demonstration agents, by assistant agents, or by club agents. There are 4,605 [3] county agricultural, home demonstration, and club agents, 471 supervisory officers, and 1,082 extension specialists.

Before 1914, when the Smith-Lever Act was passed, the Department and some of the State agricultural colleges had done some extension work. The Smith-Lever Act and specific agreements between the Department and the colleges of agriculture pooled Federal and State extension activities and funds in one national cooperative system. The extension activities of the Department were put into a new States Relations Service, which functioned until 1923, when the present Extension Service was formed.

The Smith-Lever Act specifies that the funds supporting cooperative extension work shall be expended to impart information

[2] A History of Agricultural Extension Work in the United States, 1785–1923, by Alfred C. True, may be purchased from the Superintendent of Documents, Washington, D.C., for 75 cents per copy.

[3] This figure includes 608 emergency assistants.

"through field demonstrations, publications, and otherwise." It limits the amount to be spent on publications to 5 percent of each annual appropriation. This provides the distinguishing feature of extension teaching. People are not merely told that the methods advocated are desirable; they are persuaded to try these methods, or to watch a neighbor try them so as to determine their merits for themselves.

ALL ASPECTS OF FARMING COVERED

The county agricultural extension agents now deal with every phase of farming. Before the cooperative extension system was established the chief concern of the South was to meet conditions brought about by the spread of the cotton bollweevil. In the Northern States programs were less uniform but in general were built around the questions, What are the difficulties met with in farming in the community? and What can be done to remove them? The World War began shortly after the establishment of the cooperative extension system, and production was practically the sole phase of farming that was emphasized for some time. After the war agricultural depression focused attention on economic problems, and the extension programs made more use of economic information. Production technic and economic questions are now dealt with as interrelated.

Home demonstration work originated with the giving of instruction to a group of girls in growing and utilizing tomatoes. Women soon took up the work, and it grew rapidly until it covered a wide field of farm-home activity among women in many parts of the country. The demand for food production and preservation during the World War gave impetus to the work. Selection and preparation of foods; making the farm home attractive, comfortable, and efficient; home management; child care and training; preparation and standardization of home products for sale; and other subjects are now included in the program. Material expansion of the work has been made possible by the assistance of large numbers of volunteer local leaders, who give home-economics instruction to the women and girls of their communities with the aid and advice of the home demonstration agent. Farm women participating in home demonstration activities give attention also to matters of civic and social improvement.

Farm boys and girls show great interest in agricultural extension. Some of the earliest demonstrations in the cotton-bollweevil area were carried on by the young people of the farms. Boys' and girls' 4-H clubs, conducted by extension agents, developed from the early extension work. In these clubs the boys and girls train head, hand, heart, and health. The four H's of the club name are derived from this four-sided training.

Club members range in age from about 10 to 20 years, each State making its own regulations. Members demonstrate approved practices in farming or home making. In addition, club members attend regular club meetings, exhibit work at fairs, take part in the competitive judging of agricultural or home-economics products, and attend courses at the State agricultural college for 4-H club members.

Four-H club members have carried on demonstrations in such farming and home-making activities as the growing of corn, cotton, potatoes, tobacco, home gardens, dairy and beef cattle, hogs, sheep, poultry, forestry work, food preparation, food preservation, meal planning and preparation, the making, care, and selection of clothing, room improvement, and planting of the home grounds. Each club member is asked to keep a record of his work. The annual reports of extension workers show that the percentage of club members carrying their club undertakings through to completion has increased slightly each year. The enrollment in 4-H clubs has also increased annually, amounting now to over 925,000.

Funds for cooperative extension come from Federal, State, and county appropriations and from local organizations and individual contributors. Federal appropriations are authorized by the Smith-Lever Act of May 8, 1914, the Capper-Ketcham Act of May 22, 1928, and supplementary acts of Congress. Some funds are carried in the annual appropriation act for the Department of Agriculture. A portion of the funds is available to each of the 48 States and the Territories of Hawaii and Alaska, without an equivalent appropriation by the State or Territory; the remainder, which is divided among the States and the Territory of Hawaii in the proportion that the rural population of each bears to the total rural population of the 48 States and the Territory of Hawaii must be matched by equal State or Territorial appropriations.

EXHIBITS AND MOTION PICTURES

The Office of Exhibits designs, prepares, and arranges to display exhibits relating to the work of the Department at State, interstate, and international fairs and expositions within the United States. It also designs, prepares, and arranges to display exhibits under special appropriations for such occasions as the World's Poultry Congress, and international expositions either within the United States or abroad. It is responsible for all exhibit activities of the Department. The Office has Department exhibits at approximately 70 fairs and expositions throughout the United States each year.

Motion pictures have been used by the Department for many years in disseminating agricultural information. The Office of Motion Pictures produces both sound and silent motion pictures on a wide variety of subjects, and these films are lent free to extension workers and others cooperating in agricultural education. The Office maintains a small but fairly complete laboratory and studio through which it cooperates with the bureaus of the Department and with State agricultural colleges in the utilization of the motion picture in scientific work, providing facilities for studies in cinemicrography and time-lapse cinematography. It has a library of about 250 subjects. Shipments of films to borrowers average about 4,500 per year, loan periods averaging about 2 weeks each.

FUNCTIONS OF EXTENSION AGENTS

Extension agents have an important role in the work of acquainting farmers with the purpose and opportunities of various governmental agencies organized for the benefit of farmers. For instance,

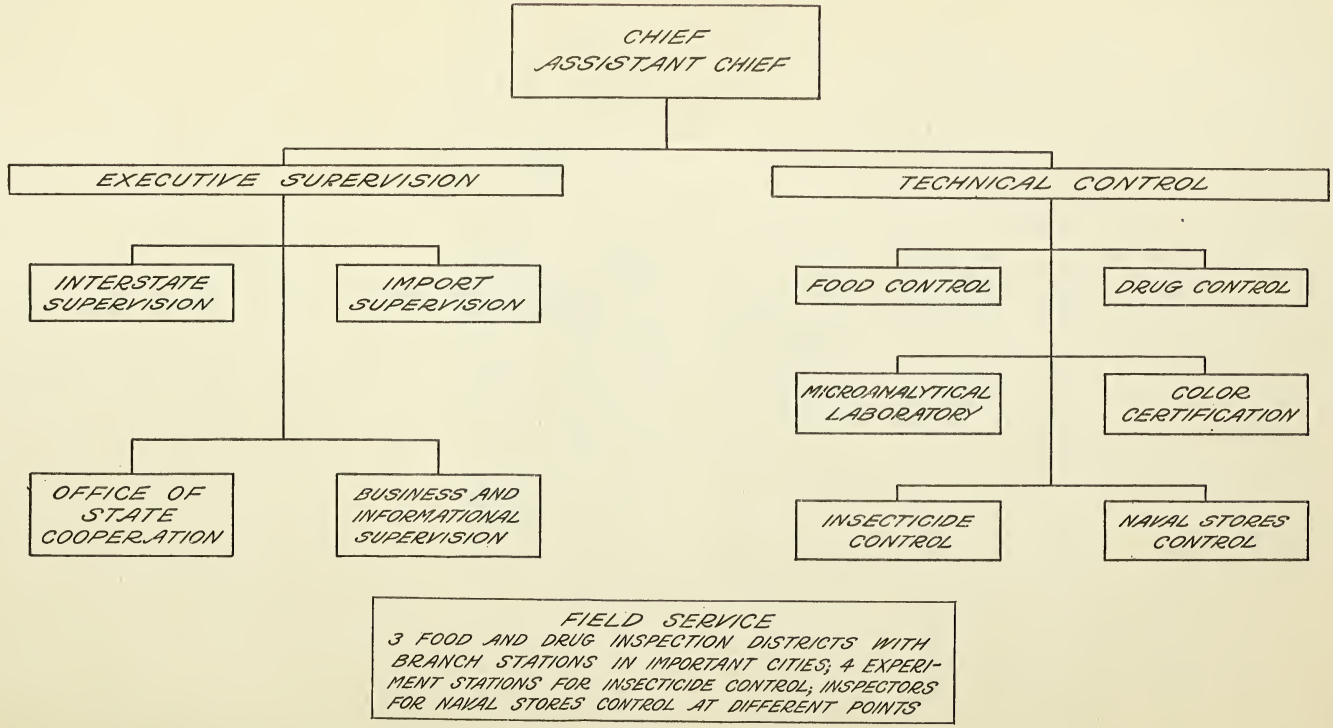
when the Agricultural Adjustment Act was passed in 1933, all county agricultural and home demonstration agents, Federal and State extension specialists, and administrative staffs were mobilized for the purpose of carrying on the educational work in support of the campaigns to control production of the various commodities. In carrying forward this responsibility in 1933, farmers were given, first, the fullest possible information on the current economic situation with reference to agriculture as a whole and to such basic products as wheat, cotton, tobacco, corn, and hogs.

This was followed by intensive campaigns to lay before farmers the provisions of the emergency plans which had been worked out to enable farmers to adjust their production in line with effective demand. Cotton was the first product to be considered. With only a few weeks in which to put the plan into effect for the 1933 crop, the extension staff in the South, supported by a volunteer staff of more than 20,000 workers, led the 6-week campaign which made it possible for more than a million growers to sign contracts to reduce their 1933 crop acreages.

Similar methods in the wheat-growing areas resulted in voluntary applications for contracts to bring more than 50,000,000 acres of wheat under the agreements calling for a 15-percent reduction in acreage for the 1934 crop. Likewise, the extension staffs were utilized for field activities in connection with production-control campaigns for the various tobacco districts and in carrying out a short emergency hog-control plan.

Extension agents are also providing farmers with complete information regarding the credit and loan facilities available through the Farm Credit Administration and the Commodity Credit Corporation, and farmers in the region concerned are being kept advised about the development of natural resources being undertaken by the Tennessee Valley Authority. Other emergency activities which have demanded the attention of extension workers include the subsistence gardens and food-preservation work undertaken for the relief of unemployed.

FOOD AND DRUG ADMINISTRATION



FOOD AND DRUG ADMINISTRATION

The Food and Drug Administration, organized on July 1, 1927, was created by Congress upon the recommendation of the Secretary of Agriculture for the purpose of promoting purity of content and truthful labeling of foods, drugs, insecticides, and certain other commodities, which are essential to the public health and economic welfare of the Nation. This purpose is accomplished through the enforcement of six specific acts of Congress. Four of these acts had been enforced for a number of years by other organization units of the Department.

The Food and Drugs Act, commonly called the pure food law, which prohibits commerce in adulterated or misbranded manufactured or natural foods, beverages, stock feeds, drugs and medicines, was enacted in 1906 and has proved to be an instrument of the highest importance both economically and from the standpoint of public health. The Insecticide Act, passed in 1910, aims to protect farmers, fruit growers, stock and poultry raisers, and others from insecticides, fungicides, and disinfectants that fall below the strength claimed for them, that will not accomplish the results promised, or that are injurious to plants or animals. The Import Milk Act prohibits the entry into the United States of milk or cream that has not been produced under prescribed sanitary conditions from healthy herds or that does not meet certain specified standards at time of entry. The Caustic Poison Act, by requiring certain labeling, aims to safeguard the household against accidental injury from ammonia, lye, carbolic acid, and other dangerous compounds commonly used in the home. The Naval Stores Act applies to rosin and turpentine used in the manufacture of paints, varnishes, and other commodities. The Tea Act provides for the examination of all tea offered for entry into the United States and the admission of only such tea as meets the standards of quality, purity, and fitness for consumption set by the Government. Because of the volume and variety of the products subject to these acts, there is required for their enforcement a unique organization and a very definite plan of operation.

PLAN OF ORGANIZATION

The personnel of approximately 575 includes administrative officers, chemists, bacteriologists, physicians, veterinarians, entomologists, plant pathologists, microscopists, pharmacologists, inspectors, and other specialists, with the necessary complement of clerks and helpers. Branch stations, manned by specialists, are maintained in 16 commercial cities of the United States to supervise interstate and foreign commerce in foods, drugs, insecticides, fungicides, naval stores, and caustic poisons. Each station is responsible for seeing that the six acts enforced by the Food and Drug Administration are complied with by the manufacturers, dealers, and importers who

trade within a specified territory tributary to the city in which the station is located. The station territories covering the entire United States are organized into an eastern, a central, and a western district, with headquarters, respectively, in New York, Chicago, and San Francisco. A responsible administrative officer directs the work of each district.

The Washington staff, consisting of approximately 200, is organized into executive supervisory officers and technical control laboratories to administer the various acts, to recommend methods for attacking regulatory problems, to conduct necessary investigations, and to solve the more difficult technological problems. At the head of the organization are the Chief and Assistant Chief, who direct and coordinate the work at Washington and throughout the entire country.

PLAN OF OPERATION

To supervise effectively the enormous traffic in foods, drugs, insecticides, caustic poisons, and naval stores throughout the entire United States with a staff necessarily limited, it is essential that a very definite plan of operation be formulated and carried out. The great majority of manufacturers are honest and desire to put out good products, truthfully labeled. If those manufacturers who do not put out a legal product can be segregated, it is possible to center attention upon these concerns and effectively supervise their operations. Accordingly, very thoroughgoing factory inspections are made and data collected which indicate the nature of the practices and products of the manufacturing concerns whose products come within the jurisdiction of the acts enforced. At the beginning of each year a program of work is developed that aims to insure that the major attention shall be given to the most flagrant abuses. This enables all districts and stations to work in unison toward a common object which will bring the maximum protection to consumers. The plan of operation developed in the enforcement of the Food and Drugs Act is applied to the enforcement of other acts administered by the Food and Drug Administration, with only such modifications as variations in the laws or in trade practices require.

PROCEDURE FOR CORRECTING VIOLATIONS

In applying the import sections of the various acts enforced, close inspection is maintained at ports. Products that do not meet the requirements of the acts are denied entry into the United States. In the enforcement of the acts in their application to interstate commerce, adulterated and misbranded products may be seized or persons responsible for the violations may be prosecuted, and after conviction may be fined and for repeated offenses may be imprisoned.

Seizure action, because of its quickness and effectiveness, is taken whenever practicable by the Federal food officials if questions of economic fraud or public health are involved. The criminal sections of the acts are invoked whenever necessary to bring about the correction of fraud or harmful practices. If a shipment of a food, drug, or insecticide product known to be adulterated passes out of or never reaches the jurisdiction of the Federal Government, the assistance of State or city food officials is enlisted and the powers

of State laws invoked to remove quickly the offending products from the market. An office is maintained for the sole purpose of promoting cooperation among Federal, State, and city food and drug control officials.

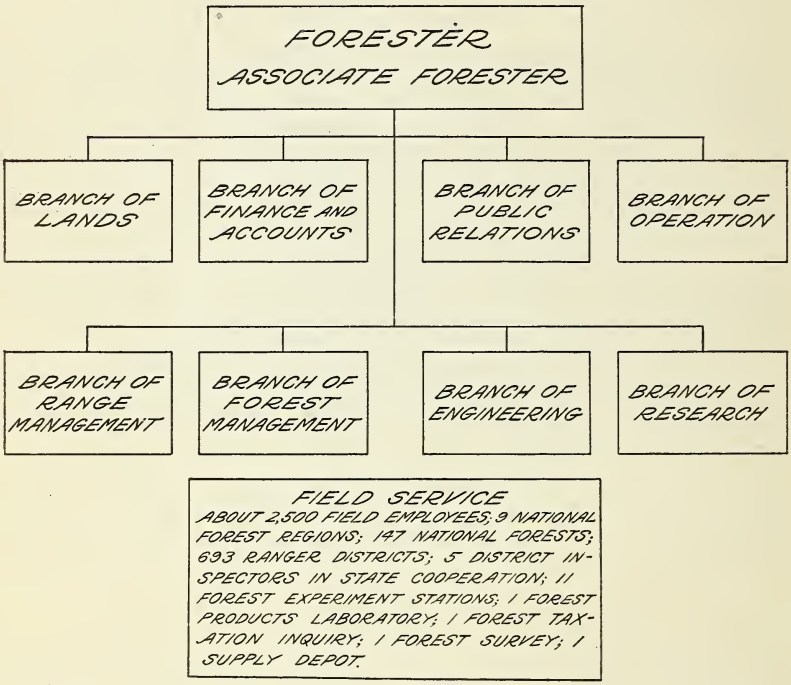
EDUCATIONAL METHODS USED

The Food and Drug Administration uses educational methods to bring about correction in the enforcement of the various acts wherever such methods will be effective, and in a large measure they are effective. To prevent violations of the acts by showing how to put out good products brings even better protection to consumers than to punish offenders after the acts have been violated.

By means of educational methods, seizure action, and prosecutions combined, the best results are obtained in regulatory work. The effective enforcement of Federal and State food and drug laws has reduced adulteration that is harmful to health. Among thousands of food samples analyzed yearly by Federal and State chemists, very rarely is a food product now found to be preserved by any of the chemical preservatives known to be harmful. Harmful contamination of packaged foods from underprocessing or other accidental causes is now extremely rare, considering the vast volume of such products annually turned out. Adulteration in food products today is mostly economic in character. It is intended to cheapen the article and may in no way affect its wholesomeness. These economic frauds, including various forms of misbranding of both foods and medicines, all designed to extract extra dollars from the consumer's pocketbook, are today the chief concern of enforcement officials.

As a result of the enforcement of the six acts administered by the Food and Drug Administration there is less adulteration and misbranding today in foods, drugs, insecticides, naval stores, and caustic poisons than ever before.

FOREST SERVICE


FORESTER
ASSOCIATE FORESTER
BRANCH OF LANDS
BRANCH OF FINANCE AND ACCOUNTS
BRANCH OF PUBLIC RELATIONS
BRANCH OF OPERATION
BRANCH OF RANGE MANAGEMENT
BRANCH OF FOREST MANAGEMENT
BRANCH OF ENGINEERING
BRANCH OF RESEARCH
FIELD SERVICE
ABOUT 2,500 FIELD EMPLOYEES; 9 NATIONAL FOREST REGIONS; 147 NATIONAL FORESTS; 693 RANGER DISTRICTS; 5 DISTRICT INSPECTORS IN STATE COOPERATION; 11 FOREST EXPERIMENT STATIONS; 1 FOREST PRODUCTS LABORATORY; 1 FOREST TAXATION INQUIRY; 1 FOREST SURVEY; 1 SUPPLY DEPOT.

FOREST SERVICE

In its broad aspects, the responsibility of the Forest Service is the development and promulgation of measures to keep one fourth of the Nation's land area productive, to insure a continuous supply of wood to meet the Nation's requirements, to obtain full benefit of the forests in conserving soils and waters, and to preserve the important social values of the forests.

The activities of the Forest Service may be divided into three major groups: (1) The protection and administration of the national forests, (2) research at regional forest experiment stations, the Forest Products Laboratory, and elsewhere upon problems in forest and range management, the utilization of wood, and in supplies of and demand for forest products of all kinds; and (3) cooperation with the States in the advancement of forest protection and forestry practice on State and privately owned land.

BEGINNING OF GOVERNMENT FOREST WORK

Government forest work had its real beginning as far back as 1876 with the appointment by the Department of Agriculture of a special agent to study general forest conditions in the United States. In 1881, a Division of Forestry was created in the Department. In 1891 Congress authorized the President to set aside forest reserves in order to protect the remaining timber on the public domain and to insure a regular flow of water in the streams. On June 4, 1897, Congress enacted a law which outlined a system of organization and management for the reserves and placed their administration under the Secretary of the Interior. The American national-forest system really dates from the passage of that act. Government administration of the reserves soon made apparent the necessity for scientific forestry to make their use general. At first the aid of experts of the Department of Agriculture as advisers was requested; but, in 1905 the administration of the forest reserves was transferred to the Department of Agriculture, and the Forest Service in its present form came into being. In 1907 the name "forest reserves" was changed to "national forests" to indicate that their resources were not to be looked upon as reserves for a distant future, but were to be administered for continuous "wise use."

THE NATIONAL FORESTS

There are at present 147 national forests, located in 30 States and 2 territories and having an aggregate net area of more than 160,000,000 acres. Of this total, approximately 153,000,000 acres or 96 percent is located in the 11 far Western States and Alaska and is made up of public-domain lands, chiefly valuable for watershed protection and the production of forests. The remaining 7,000,000

acres are located in the Middle Western, Eastern, and Southern States. This acreage consists in part of lands reserved from the public domain and in part of purchased areas. Additional lands are being purchased in the Lake States and the East and South as Congress appropriates money for that purpose.

The basic natural resources of the national forests—including wood, water, and range forage—are managed for continuous production, and their recreational opportunities are conserved.

The policy in administering the national forests is to provide for the maximum use consistent with the purposes for which they were created; to provide a permanent supply of timber and protect the watersheds which they contain. Following this principle, the national forests are open under proper regulation for a great variety of uses. For those of a commercial nature, charges are made consistent with the value of the products removed or concessions granted. The annual average of receipts for the 10-year period 1921–30 was more than $5,000,000, as against an average of a little over $3,000,000 annually for the decade 1911–20. These receipts came from the use of timber, the use of forage, and from miscellaneous uses, including the use of land, water-power sites, and other special uses. Receipts from timber sales make up about two thirds of the annual total and grazing fees amount to more than one fourth of the total. Twenty-five percent of the receipts are turned over to the States to be prorated to the counties containing national forests for roads and schools.

The national forests contain approximately 20 percent of the forested area of the country and a total estimated stand of 552,000,000,000 feet of merchantable timber. Mature timber is sold from the national forests as there is demand for it, but not in quantities in excess of the annual growth. Cutting is done under Forest Service supervision on the principle of sustained yield, whereby adequate provision is made for successive crops of timber on the same land.

OTHER USES OF THE NATIONAL FORESTS

In addition to assuring permanent timber resources, national forests protect the watersheds of a considerable proportion of the water-power resources of the country and the water supplies of some 800 municipalities. They also furnish summer range for nearly 14 million head of livestock of all ages. Ranges are managed for continuous forage production as well as for soil conservation and watershed protection.

Millions of people visit the national forests every year for outdoor recreation, hunting, fishing, camping, hiking, and so on, and thousands of summer homes are located on them.

The national forests constitute the largest and best big-game grounds in the country. They are maintained at public expense for the use and benefit of all the people. Unlike the private game preserves, they keep open for the everyday American opportunities for the enjoyment of sport and recreation which in European countries are restricted to the privileged few. Wherever through game protection the principle of highest and fullest use of the national forests can be served, game-management plans are developed. These plans

are based on facts obtained through studies conducted by the Bureau of Biological Survey and through the observations of local forest officers. The national forests contain 258 State game refuges and 20 Federal refuges, located in 24 States and Alaska, and covering more than 21,000,000 acres.

Under the authority of a departmental regulation promulgated in 1930, the Forest Service is establishing a series of representative areas within the national forests to be known as primitive areas. In these areas primitive conditions of environment, transportation, habitation, and subsistence will be maintained, with a view to conserving permanently the value of such areas for purposes of public education and recreation.

FORESTRY RESEARCH

To meet the requirements of the country for forest products, to conserve the esthetic and recreational values of our forests, to maintain their beneficial effects on stream flow, and to prevent erosion, require the development of forest management for a wide variety of climatic, topographic, soil, and economic conditions. There are now 11 regional forest experiment stations, representing the most important timber-producing regions of the country. Research at these stations aims to work out methods of cutting which will insure natural regeneration of the forest to obtain full timber crops in the shortest possible time, and to secure information upon which proper reforestation of denuded lands can be based. It also deals with the protection of forests through analyzing the damage done by fire, studying possibilities of reducing hazard, eliminating causes and predicting periods of extreme fire danger; and works out proper methods of handling forest lands to check erosion and soil washing.

The aim of forest-products research, conducted largely at the Forest Products Laboratory of the Forest Service at Madison, Wis., is to aid in making timber growing profitable through more efficient utilization, and to aid in providing the public with needed forest products. The enlargement of merchantable yields, the utilization of waste and of species now considered inferior or worthless, and the development of new uses and improved practices are involved. The determination of the chemical composition and physical structure and properties of all species is required. It is also necessary to know how these are affected and may be controlled by the conditions of growth, and how the material may be most efficiently harvested, selected, prepared, modified, adapted to service, and converted into usable byproducts.

Range research is conducted at forest experiment stations and elsewhere to determine how to use lands suitable for grazing to best advantage. The information is needed primarily for proper administration of more than 80,000,000 acres of national-forest land, and is applicable in part to other range lands, in public and private ownership. It is essential to learn not only how to maintain and increase range productivity for livestock grazing but also how to prevent erosion and to preserve the watershed values of these grazing lands.

Forest economic investigations deal with the economic aspects of forest production and forest-land utilization, which largely deter-

mine the extent to which the results of other fields of forest research can be applied, and underlie the formulation of sound public and industrial forest policies. Among the economic investigations under way are: A Nation-wide appraisal of our forest resources, of the present and potential growth, of the drain upon the forests through cutting, fire, disease, and insects, of the present and prospective needs of the Nation for forest products, and of economic relationships; an investigation of forest taxation; a study of the costs and returns, and the financial feasibility of forestry as an economic undertaking by private owners; and a study of the possibilities of forest insurance.

Certain areas within national forests are designated as experimental forests, to be maintained as outdoor laboratories for research in silvicultural and other forest practices in each forest region. A supplemental series of areas known as experimental ranges is set aside for range investigations. The Forest Service is designating also a series of natural areas sufficient in number and extent adequately to illustrate or typify virgin conditions of forest or range growth in each forest or range region, to be retained in a virgin or unmodified condition for purposes of science, research, historical interest, and education.

STATE COOPERATION

By the passage of the Clarke-McNary Act of June 7, 1924, Congress adopted a national program of forestry which provides for Federal cooperation with the several States in the protection and reforestation of State and privately owned forest lands. The act authorizes and directs the Secretary of Agriculture—

> under such conditions as he may determine to be fair and equitable in each State, to cooperate with appropriate officials of each State, and through them with private and other agencies therein, in the protection of timbered and forest-producing lands from fire.

The Forest Service is responsible under direction of the Secretary of Agriculture for the administration of this act and for securing results from Federal moneys expended. Thirty-eight States and one Territory are now cooperating with the Federal Government under the fire-protection benefits of this act, and the total acreage of State and private lands under some form of organized protection against fire is in excess of 220,000,000 acres.

The Clarke-McNary Act also provides that the Federal Government shall cooperate with the several States in the procurement, production, and distribution of forest-tree seeds and plants, for the purpose of establishing windbreaks, shelter belts, and farm wood lots upon denuded or nonforested lands within such cooperating States.

The cooperating State contributes at least one half the funds needed for this work. Nearly 40 States and 2 Territories are now cooperating with the Federal Government in accordance with the provisions of this section of the act, the work being done under general supervision of the Forest Service. Approximately 25,000,000 seedlings have been distributed annually for farm planting during recent years. In most of the States the stock is distributed at cost.

The Federal Government and the States also cooperate under the Clarke-McNary Act in giving aid to woodland owners through extension activities.

Through publications and other informational means, the Forest Service carries on continuous educational work in the interest of sound forest practice and forest protection. Results of forest research are given to the public in both technical and popular bulletins; other educational material is prepared and distributed. Each year the Forest Service receives thousands of requests for information. Members of the Service are always ready to give information and advice on problems of forest conservation, protection, and management.

DEVELOPMENTS IN 1933

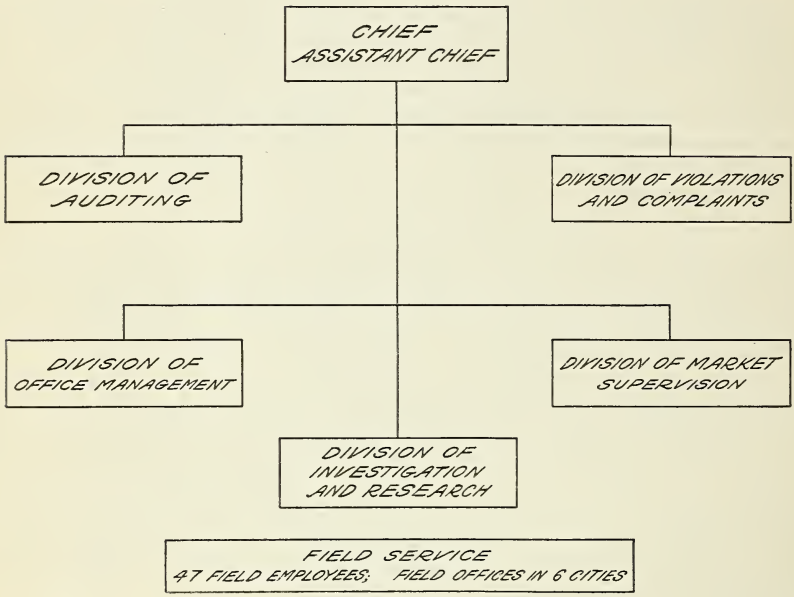
Developments gave a tremendous stimulus to the forestry activities of the Department, and a new outlook on the future. This was partly due to the initiation of the emergency conservation work and the unexpected allotment of more than $60,000,000 for land acquisition and for national-forest improvement and development work in addition to that which the Civilian Conservation Corps is doing. It should be possible to accomplish within a short term of months that which, as matters have gone in the past, could not have been completed within many years. Even more important is the prospect for comprehensively planned land use. Forestry and agriculture supplement and help each other and must be brought into a rationally adjusted balance that will make the most effective use, in the common interest, of the interlocking soil and water resources of the country as a whole.

The emergency conservation work was authorized by the Unemployment Relief Act, passed March 31. Three months later there were on the national forests 591 camps, each containing 200 previously unemployed young men from 18 to 25 years old who in the interval had been selected, assembled, made physically fit for work, and transported (in some cases 2,500 miles) to the designated locations. This was carried out under a Director of Emergency Conservation Work, with the Departments of Labor, War, Interior, and Agriculture cooperating.

On the national forests the Forest Service selected the projects and camp locations, provided work equipment and transportation, and supervised the field performance. It advised with and assisted the State authorities in planning and executing the emergency conservation work on State and private lands, except on parks, and had general supervision of this part of the undertaking. The number of these camps is 658.

The industrial-recovery and public-works legislation afforded a means of going still farther in providing for the improvement of the national forests.

GRAIN FUTURES ADMINISTRATION



GRAIN FUTURES ADMINISTRATION

The Grain Futures Administration in its work of administering the Grain Futures Act maintains supervision of trading activities on the principal grain exchanges of the United States.

Grain futures transactions (trading in grain for future delivery) originated in Chicago prior to the Civil War, as an outgrowth of dealing in "time contracts" involving the purchase of grain for deferred delivery. Sales of grain by time contract were recorded at Chicago as early as 1848 and gradually became important. At that time grain was transported from Chicago almost exclusively by water during the period of open navigation on the Great Lakes, and 6 weeks were required for information about grain prices at Liverpool to reach Chicago. Hence considerable risk attached to the ownership of time contracts, and extended speculation developed therein. This speculation reached vast proportions during the Civil War. It was not until 1865, however, that trading in grain futures was recognized as a distinct commercial practice in the rules of the Chicago Board of Trade.

LEGISLATIVE HISTORY

Dissatisfaction developed among producers and others as a result of erratic price fluctuations associated with the widespread trading in futures contracts. By 1884 this feeling brought about the introduction of congressional legislation to combat manipulation and market corners. The upshot was the enactment in 1921 of the Futures Trading Act. This law, designed to prevent manipulation of the Nation's grain markets, was based upon the taxing power of Congress. It was attacked in the courts and was declared unconstitutional by the Supreme Court in 1922. Then followed the enactment of the Grain Futures Act of 1922, having the same general purpose as its predecessor, but based upon the power of Congress to regulate interstate commerce. This legislation was sustained by the Supreme Court in 1923, and rules and regulations for the enforcement of the act were promulgated by the Secretary of Agriculture on June 22, 1923.

Congress, in the Grain Futures Act, declared that transactions in grain futures on organized grain exchanges were "susceptible to speculation, manipulation, and control", with the result that "sudden or unreasonable fluctuations" in grain prices frequently occurred. Such abrupt or unreasonable price changes were declared "an obstruction to and a burden upon interstate commerce in grain" and its products, and the regulation of futures transactions was pronounced "imperative for the protection of such commerce and the national public interest therein."

EXCHANGES MUST BE LICENSED

As the first step in the regulation of futures transactions on grain exchanges, the act provides that only on an exchange that fulfills certain statutory conditions, and is designated by the Secretary of Agriculture as a "contract market", may transactions in grain futures be conducted. The conditions precedent to designation are: The exchange must be located at a terminal market where grain is sold in sufficient volume and under such conditions as fairly to reflect its general value and the differences in value between its various grades and where an official inspection service, approved for the purpose by the Secretary of Agriculture, is available. Further, the governing board of the exchange must provide for: (1) The making and filing of reports showing the details of all transactions of the exchange or its members both in cash grain and grain futures, as may be required by the Secretary of Agriculture; (2) the prevention of dissemination by the exchange or any member of false or misleading information tending to affect the price of grain in interstate commerce; (3) the prevention of manipulation of prices or the cornering of grain by dealers or operators upon the exchange; (4) the admission of responsible farmers' cooperative associations; and (5) making effective final orders and decisions rendered by the Government incident to the violation of certain provisions of the act.

The following 15 grain exchanges have been licensed as contract markets: Board of Trade of the City of Chicago, Chicago Open Board of Trade, Minneapolis Chamber of Commerce, Duluth Board of Trade, Kansas City Board of Trade, St. Louis Merchants Exchange, Milwaukee Grain and Stock Exchange, Baltimore Chamber of Commerce (inactive as a futures market), Los Angeles Grain Exchange, Grain Trade Association of the San Francisco Chamber of Commerce, Seattle Grain Exchange, New York Produce Exchange, Portland Grain Exchange, Omaha Grain Exchange (inactive as a futures market), and Hutchinson Board of Trade Association.

ACTIVITIES OF THE ADMINISTRATION

The Administration exercises immediate supervision of grain futures transactions on the contract markets, the aggregate of which has averaged 20 billion bushels per year during the past 10 fiscal years (July 1, 1923–June 30, 1933), through its six field offices located at Chicago, Ill., New York, N.Y., Minneapolis, Minn., Kansas City, Mo., Seattle, Wash., and Sacramento, Calif.

The members of each contract market are required to keep records of all transactions both in cash grain and grain futures. These records are subject at all times to the inspection of representatives of the Grain Futures Administration and the Department of Justice. Each clearing member of these exchanges is required also to report daily to the Grain Futures Administration: (1) The aggregate volume of both purchases and sales, (2) the aggregate of all customers' "long" and "short" accounts that are open on the books at the close of the day's business, and (3) the quantity of grain received and delivered on futures contracts. From these reports, which are filed in the respective field offices of the Administration,

are published each day for the principal contract markets the total volume of trading in each future and the total open contracts therein.

The market position of each individual trader whose account reaches a certain designated amount, varying with the different grains and different markets, is also reported daily for the confidential information of the Administration. The individual accounts covered by these reports are styled "special accounts", as they frequently amount to considerable volume, and often have an important influence in price movements. The information presented by these special-account reports is helpful in lessening congestion during delivery months and in preventing corners, and affords the Administration knowledge of developments that might otherwise lead to serious abuses.

The work of the Grain Futures Administration also includes the checking of the dissemination of false, misleading, or knowingly inaccurate information tending to affect the price of grain; and the general observation of the Nation's grain-marketing machinery with a view to seeing that price movements are kept free from manipulative influences.

Reports are published from time to time by the Administration for the information of Congress and the public with respect to the data compiled from the daily reports of clearing members of the contract markets, supplemented by the continuous observation of activities on most of the larger exchanges, and by special investigations, surveys, and research.

In cooperation with other Government agencies, the Administration investigates supply and demand conditions, handling and transportation charges, and final costs to consumers of grain, grain products, and byproducts.

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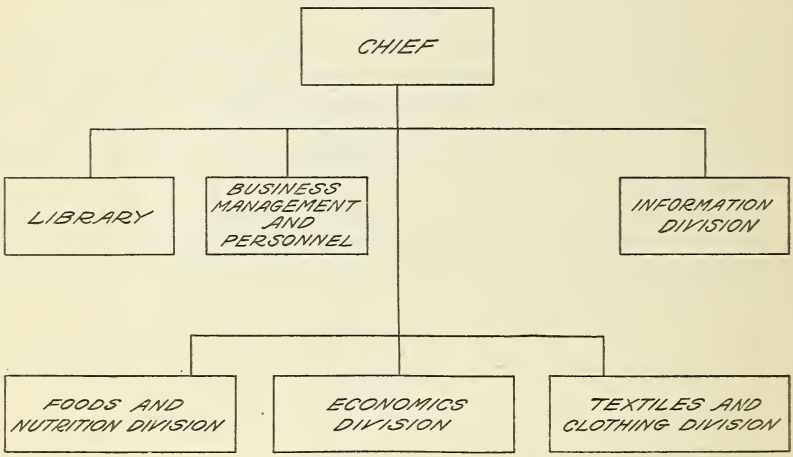
BUREAU OF HOME ECONOMICS



BUREAU OF HOME ECONOMICS

The 29 million homes of this country are our great consumer market. They use what the farmer grows and what the factory makes. They buy what the merchant sells. The homemaker is the chief purchasing agent for the home.

In the Department of Agriculture the home has long been recognized as a controlling factor in the consumption of farm products. Home economics research, gradually widening in scope, has been conducted for more than 40 years as a part of the Department's work, first through cooperation with the State experiment stations and then through the Extension Service. In 1923 home economics was put on a footing with other departmental branches of research. The Bureau of Home Economics was organized to study household management, standards of living, and "wise use of agricultural products as food and clothing in the home."

Since then, this bureau has carried forward the lines of research that were previously under way. It has developed new lines and translated the scientific results into practical information for the homemaker. Its work deals with nutritive value in foods, diets that safeguard health, quality and money value in clothing materials and other household purchases, and methods of household work and management. The Bureau gives the same kind of scientific help to the consumer that other branches of the Department give to the farmer and other producers.

The work of the Bureau of Home Economics is organized with three main divisions of research. One deals with foods and nutrition, another with household textiles and clothing, another with economic studies of home problems.

FOODS AND NUTRITION

The first Government program for nutrition research, undertaken in 1894, included "investigations of the cost, composition, and nutritive value of food materials." It included also "studies of the laws of nutrition of humans" and called for compilation of results of previous nutrition investigations, the improvement of research methods, and the publication of results in both technical and popular form.

One of these early studies resulted in an authoritative work on the chemical composition of American food materials. This book is still the standard work of reference on this subject, a handbook for dietitians and doctors in calculating diets and even for advertisers who wish to draw attention to the calories or the lack of them in the foods they are selling. Year by year, as more analyses of foods are published and new foods come on the market, the Bureau revises these food-composition tables and makes available unbiased, reliable data for the use of all. Recent summaries give the compo-

sition of nearly 200 fruits and vegetables—all of the common and some of the rare kinds used in the United States.

The nutrition laboratories carry on original work in this field. Vitamin studies are the chief work so far undertaken. Assays of different foods disclose their value as sources of the various vitamins. Included in the list so far tested by the Bureau are several varieties of spinach, green and white lettuce, broccoli both raw and cooked, yellow- and white-fleshed potatoes, grapes and grape juice, honey and honeycomb, green tea, green and ripe olives, watermelons, cottonseed flour, rice polishings, and wheat germ. Some of these foods proved rich sources of one or more vitamins, others negligible sources. Only through exact knowledge of this kind can we be sure of getting the essentials for good nutrition. The vitamin A and D content of egg yolk in relation to the feed of the hen has been studied jointly by this Bureau and the Bureau of Animal Industry, with a view to developing a commercial method of producing eggs of known vitamin content. Tables summarizing data on the vitamin content of foods investigated by laboratories in this and other countries are published in cooperation with the Office of Experiment Stations.

Practical aspects of the food-research program are developed in the experimental kitchens. Staff specialists work out methods of preparing foods for the table so as to conserve nutritive values and make attractive and economical dishes. In cooperative experiments scientific meat-cooking methods are applied to cuts of meat from animals raised on State and Federal farms. These tests show the relation of age, sex, feed, breed, and other production factors to the cooking quality of the meat. For the homemaker, the scientific principles of meat cookery are put into standard directions and recipes for roasting, broiling, braising, and preparing all the different kinds of meats according to the cut.

Tests of the cooking quality of potatoes and other vegetables are conducted in the same way, in cooperation with the Bureau of Plant Industry. Another project includes the testing of eggs for their cooking quality and leavening power, and correlates these points with the feed and management of the poultry. Comparative tests of lard of different types and of other cooking fats are in progress, to show the effect of each fat upon the flavor of the food with which it is used.

Home canning and other methods of food preservation are studied. In farm homes, especially in connection with live-at-home programs, it pays in money as well as in family health to have a good winter supply of home-canned fruits, vegetables, and meats. Sometimes foods are put up by methods that do not insure adequate sterilization. The result is spoiled food and sometimes serious cases of food poisoning. On the basis of extensive research, the Bureau recommends only the steam-pressure method for processing beans, peas, corn, and the other nonacid vegetables as well as meats. During the economic crisis canning centers were organized in thousands of communities. As an aid to the relief workers in equipping and operating these centers, often with assistants untrained in the technique of canning, special material was prepared which helped in the conservation of large quantities of fruits and vegetables.

Meal planning is both a science and an art. In its scientific aspects it is based upon nutrition studies and scientific methods of selecting and preparing food. The health of the family depends upon the homemaker's knowledge of certain principles of diet, of the nutritive values of the common foods, and of the proportions in which they are served. Information of this kind, concretely illustrated with menus and recipes, is prepared by the Bureau's specialists and distributed widely. The feeding of children is studied in the nutrition laboratories and in cooperating child-research centers and nursery schools. Results of the research work are translated into practical terms of diet and published both in technical form for students and in terms of daily meals at home or school.

TEXTILES AND CLOTHING

So far the work on textiles has centered on cotton and wool because of their importance to American agriculture. Wearing qualities of fabrics made of different grades of cotton and wool fibers of known history are being determined. Through a cooperative arrangement with other bureaus in the Department and with State agencies, the study starts with the cotton in the field and the wool on the back of the sheep, and the record covers every step through spinning, weaving, and on to the use by the consumer of the finished fabric until worn out. As with the quality studies on meat, potatoes, and lard, these textile studies link production and consumption in a complete way. They are a practical guide to the grower in showing him how his cotton or his wool of certain grade stands up when woven into a sheet or a blanket. They also supply some of the facts needed for the labeling of textiles to meet consumer standards. In addition, facts that will help the homemaker in judging quality when she buys textiles for clothing and for household purposes are brought together from all available sources.

New ways of using standard fabrics in women's and children's clothing and house furnishings are found, and in cooperation with manufacturers new fabrics are developed to meet some special need. Osnaburg, for example, a fabric made of low-grade cotton, has long been used in the South for cotton-picking bags and work clothes. The Bureau of Home Economics saw in it possibilities for hangings and covers for chairs and couches because of its resemblance to natural-colored linen crash. The test made by the Bureau and the illustrative material sent out resulted in the sale of osnaburg all over the country as a low-priced artistic fabric for interior decoration. A durable cotton fabric as the foundation for hooked rugs was developed to replace the imported jute burlap which often gives way quickly. To the women who are making hooked rugs as a home industry, this is a matter of practical and economic importance.

The designing of clothing for children combines better utilization of cotton and wool fabrics with the new ideas of child hygiene and psychology. Each garment is so designed as to encourage self-help, active play, and good posture, and also give good service and be as easy to make and care for as is consistent with good standards. Thirty of these original designs have been put on the market by

commercial pattern companies. Under the auspices of child-welfare organizations and other educational groups, each year thousands of women see the traveling exhibits of the garments themselves. Retail stores also send their buyers to study these scientifically designed clothes for children, and manufacturers are incorporating many of the features in ready-to-wear garments.

Of special help to relief agencies are the directions and illustrative material on remodeling clothing and the selection of equipment, patterns, and fabrics for community sewing rooms. In these, as in the community canning centers, great savings were effected and better products turned out by following standard methods.

ECONOMIC STUDIES

Studies of food budgets, clothing budgets, and living standards tie in with the research of the other Department bureaus. Master diet plans are typical. They translate the scientific facts on food values and nutrition into pounds and quarts of food on a two-way basis—nutritive content and cost. First in these master diet plans is a liberal diet for use when there is plenty of money to spend on food. Then come moderate-cost and minimum-cost diets, adequate in nutrition but allowing few luxuries. At the bottom of the scale is a restricted diet only for emergency use in time of crisis. It shows how to lay out a meager amount of money so as to get the greatest return in food values. It represents quantities of food, especially "protective" foods rich in minerals and vitamins, below which no diet can safely fall. The liberal diet is the ideal one. If adopted by the country as a whole, it would raise health standards far above the present average.

Each of these four diets is given on a general per capita basis, and also for individuals from babyhood to adult age and for families of different make-up. So practical and so definite are these plans that an extension worker can sit down with a farmer and his wife and help them make out a food budget for the year ahead telling exactly how much of each kind of food they need to grow at home and how much they will have to buy to keep the family well nourished. Or a social worker advising a group of city women can help them draw up market lists to suit their incomes, and safeguard the family health.

Relief workers and others cooperating in this plan for a low-cost diet helped many families to weather the economic crisis without permanent damage to health. The adequate diets at minimum and moderate cost recommend freer use of milk, vegetables, fruits, lean meats, and eggs. They appeal more to the appetite, and they furnish a generous margin of safety on the nutritive side. The liberal diet at the top of the scale will promote better-than-average nutrition.

In cities many families of skilled wage earners and well-to-do business and professional men spend enough money to serve this liberal diet on their tables regularly, but probably relatively few select food which has so high a nutritive value. Certainly far too few farm families have food that reaches this high level. A survey of a group of farm and village families in what is normally a prosperous part of central New York State showed that while their food had a money value somewhere between the minimum- and moderate-

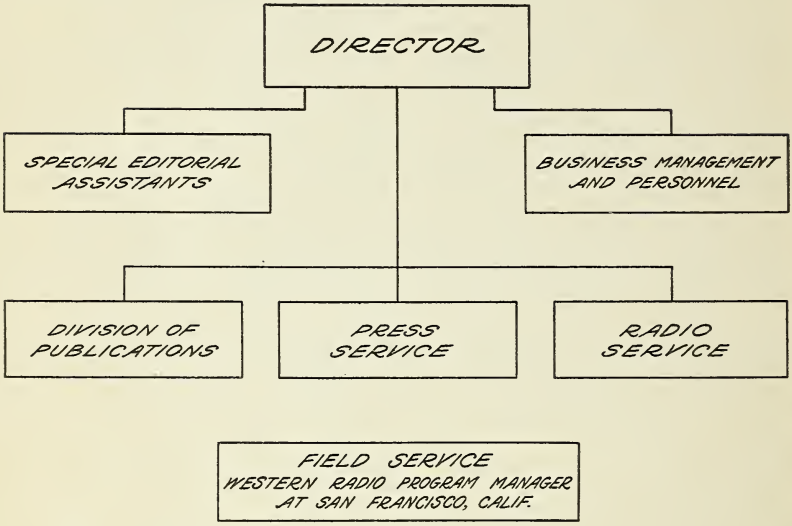
cost adequate diet mentioned, the diets of more than two thirds of the families were not adequate nutritionally as judged by our present standard.

Typical of the standard-of-living studies that the Bureau makes from time to time in cooperation with other agencies, is a report on the mountain families in Knott County, Ky., and Grayson County, Va. Visits were made to over 600 families in these two sections of the southern Appalachian highlands, and facts were collected on housing, clothing, and food. A follow-up study the next summer gave detailed facts on dietary habits for the use of extension workers in educational programs to improve living conditions.

One of the outstanding food-consumption studies so far completed covered a group of 73 South Carolina farm families many of whom suffered periodically from pellagra. Careful records were taken of their food supply and the quantities and kinds of foods they ate over typical periods in the fall and spring. The South Carolina State Board of Health cooperated by making physical examinations and diagnosing the pellagra symptoms. Not only was it possible to relate the incidence of the disease directly to the food supply but it was also possible to demonstrate to these families exactly wherein their diets were deficient and to tell them the quantities of milk, fruits, vegetables, lean meats, and other foods needed to bring their food up to an adequate standard. These facts also enabled agents of the Extension Service in this South Carolina county to work out with the farmers themselves a program of food production and conservation that prevents pellagra and improves the general health.

The results of all this research are published in technical reports for scientific workers. Bulletins, charts, lantern slides, and film strips are prepared for teachers, welfare workers, and students. For homemakers, the facts are put into everyday language, and given out through the press and by other printed means, over the radio, and in correspondence.

OFFICE OF INFORMATION



OFFICE OF INFORMATION

The fundamental purpose of the Office of Information is to aid in carrying out one of the two great tasks set forth in the organic act of the Department—the dissemination of information made available by the research done in the Department. The Extension Service and the Office of Information supplement each other in this undertaking.

The Office of Information is in no wise a publicity agency in the usual sense of that term. Its purpose is not to acquire prestige for itself nor for the Department as a whole, nor to "sell" the Department to the public, nor to advertise the achievements of Department workers, but to make public the results of the Department's manifold activities. It helps in removing the disparity between agricultural science and agricultural practice. Economic data issued through the Office of Information help farmers individually and collectively to plan their production.

This Office handles all major questions affecting the informational activities of the Department, including editorial matters, printing, illustrating, publishing, and distributing published material. It supervises and coordinates publication activities, and press and radio information for all the bureaus and offices of the Department, most of which maintain editorial offices. The 48 agricultural colleges and 53 experiment stations cooperate with the Office of Information in coordinating national and regional information. The Office also cooperates with the Joint Conference on Printing with the congressional Joint Committee on Printing, and with the Public Printer in developing effective publication methods. It has three main sections—Division of Publications, Press Service, and Radio Service.

DIVISION OF PUBLICATIONS

The Department's publishing program, an outgrowth of 70 years' experience, is adapted as closely as possible to the needs of farmers, research institutions, extension groups, and the general public. Publications are classified according to the needs of different groups of readers. Scientific workers demand much more detailed and precise accounts of research than do farmers and other nontechnical readers. Fundamental-research accounts are published in Technical Bulletins, Statistical Bulletins, in the periodical Public Roads, and in the Journal of Agricultural Research, primarily for technicians, teachers, and students. Semipopular material is published in Circulars and Miscellaneous Publications. The popular publications consist mainly of Farmers' Bulletins, Leaflets, and the Yearbook of Agriculture. A number of popular and semipopular periodicals, largely for the Department's own personnel, are issued.

The Department distributes free approximately 25,000,000 publications annually. In addition, the Superintendent of Documents

sells about 1,000,000 copies each year. By law, Members of Congress are entitled to distribute four fifths of the copies of Farmers' Bulletins. Persons who want Farmers' Bulletins may therefore obtain them from their Senators or Representatives.

One of the best-known Department publications is the Yearbook of Agriculture, which has an annual circulation of about 400,000 copies. This volume contains the annual report of the Secretary of Agriculture to the President, numerous short articles by Department specialists on recent progress in agricultural science and practice, and a large section of agricultural statistics. It is intended primarily for the farmer.

In addition to the principal publications, much material, both technical and popular, is issued in mimeographed and multigraphed form. The annual output of such material is about 52,000,000 pages.

PRESS SERVICE

So that the Department's economic and scientific information may reach the public quickly and regularly through the daily and periodical press, the Department maintains a Press Service in its Office of Information. This division issues press releases direct to newspapers, farm journals, trade publications, magazines, press associations, and correspondents, and furnishes special writers with material for articles. Its function has become doubly important since the enactment of the Agricultural Adjustment Act. It is partly through the facilities of the Department's Press Service that the country learns about acreage-control programs, marketing agreements proposed or concluded, processing taxes imposed, and benefit payments made. Also the Press Service issues articles intended to acquaint farmers and the public generally with the nature of the problems agriculture faces. These problems, of course, are technological and regulatory as well as economic. Accordingly, the articles reflect a synthesis of all the work of the Department. Writers in the Press Service assemble the data in an accurate and usable form. Editors appreciate this service because it would be costly and troublesome for reporters to examine the numerous points usually involved in scientific discoveries.

Newspapers, farm journals, and periodicals, carry information furnished by the Department's scientists, and by the economic and regulatory services, in a uniquely useful manner. Nothing can rival the press in circulating information quickly and widely. Much information gathered by the Department depends for its value on immediate publication. This is particularly true of crop and market news and regulatory articles. Such material, moreover, must be distributed not only without delay but with accuracy and detail. It must be put out in print for reference. Other data gathered in the Department, though not so dependent for their value on quick publication, equally require a record in printer's ink. This is true of scientific discoveries, farm-management recommendations, and announcements regarding plant pests and diseases. Indeed, much important departmental information gets out only through the press. Also the press circulates much information, which, for lack of Government

funds to publish it, might otherwise not see the light of day for years. As is well known, the Department itself can publish only a part of the scientific knowledge it accumulates.

RADIO SERVICE

The Department of Agriculture established a Radio Service in 1926. Previously the Department had used the radio only to send weather reports and market news to the public. The Radio Service undertook to supply cooperating stations throughout the country with informational and educational programs reporting results of the Department's work. Today more than half of the 600 radio stations in the United States cooperate daily with the Department. Some broadcast only market news or weather reports. More than 250, however, also transmit Department educational and informational programs. The Department issues two types of informational and educational programs. One type is the network broadcast; the other is the broadcast through individual stations. The programs through individual stations have been issued since 1926. They are prepared in manuscript form. At first they were sent direct to the stations. For the past 3 years, however, a system has been gradually organized so that the manuscript programs from the Department go to the stations in nearly all the States through the office of the State agricultural extension editor. The extension editor revises and adapts the national programs, and complements them with information coming from the research and service work of the State agricultural research and extension agencies.

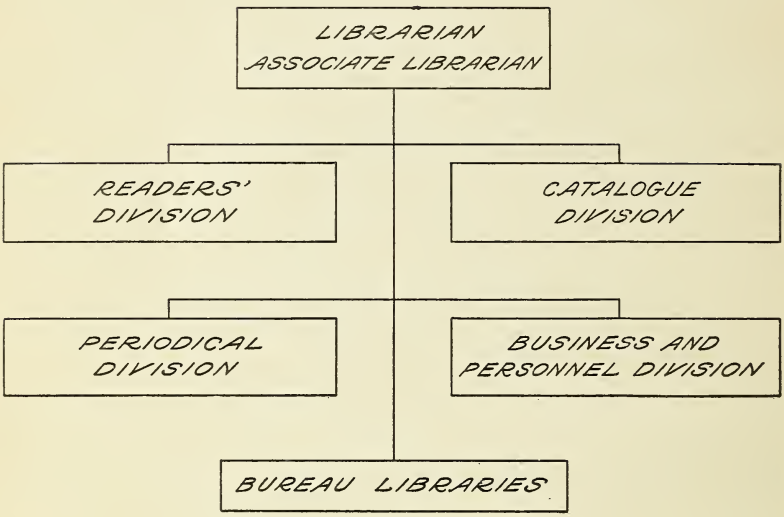
This system now is effective in 41 of the 48 States. It applies as yet only to the agricultural programs, the daily service known as "the Farm Flashes." The daily service carrying information for homemakers and known as the Housekeepers' Chats still goes direct to stations. So does the weekly service of information to consumers from the Food and Drug Administration known as Uncle Sam at Your Service. At present 237 stations broadcast the Department's manuscript service.

The network broadcasting companies also have made available to the Department much broadcasting time for taking information to farmers and homemakers. The National Broadcasting Co. has put at the Department's disposal a daily period in the National Farm and Home Hour and the Western Farm and Home Hour. The Department broadcasts in these programs from Monday to Friday, inclusive. The National Farm and Home Hour is transmitted by 48 stations, and the Western Farm and Home Hour by 10 stations. Through these daily broadcasts over the networks the Department keeps the radio audience in close touch with new developments of the program of agricultural adjustment and new findings of the scientists and economists. Besides this daily service over the NBC networks, this company and the Columbia Broadcasting System from time to time make available to the Department and cooperating agencies networks for special single programs, or for short series. Three different series of morning broadcasts by the Food and Drug Administration designed to teach consumers how to "read the label"

on foodstuffs and drugs, have been given over NBC networks. A special series of evening programs supporting campaigns for adjustment of wheat, cotton, and tobacco acreage have been carried both by NBC and CBS networks. A weekly afternoon broadcast has been arranged over NBC in collaboration with the General Federation of Women's Clubs. The aim of this series is to keep consumers informed concerning the relation of the agricultural-adjustment program to them.

All radio facilities are furnished to the Department without charge by the broadcasting stations and networks.

LIBRARY


LIBRARIAN
ASSOCIATE LIBRARIAN
READERS' DIVISION
CATALOGUE DIVISION
PERIODICAL DIVISION
BUSINESS AND PERSONNEL DIVISION
BUREAU LIBRARIES

LIBRARY

The Library of the Department is scientific, technical, and statistical in character. It furnishes the books, periodicals, and newspapers needed for consultation in carrying on the work of the Department and the reference service required in the use of the collections. In all the Department's activities it has a service to perform, not only in the research work but also in the extension and regulatory work. The total collections of the Library, exclusive of those of the Weather Bureau, now number approximately 245,000 volumes. The periodicals received currently number approximately 4,300 and an even greater number of serials such as annual reports, proceedings, and transactions, are currently received. The day's mail brings books, periodicals, and exchanges from every civilized country and in every language in which scientific data are recorded.

The Library may be said to have been established in 1862 when the Department was established. Its foundation was in fact laid even earlier, in the Agricultural Division of the Patent Office. While the need of a library of scientific literature to facilitate its work was recognized by the Department from its very beginning, the development of the Library during the first three decades of its history was unfortunately slow, its quarters cramped, and its service limited. The year 1893 marked a new era in its history. In that year a new librarian was appointed through Civil Service examination, the Library was reorganized, and modern library methods were introduced. Since that date the Library appropriations for books and personnel have been steadily increased to meet the expanding needs of the Department.

ORGANIZATION

On account of the size of the Department its many offices are scattered in various buildings, some of them at considerable distances from the central offices, necessitating the filing of work collections in many of these scattered offices. Instead, therefore, of a single library collection in the main building of the Department, as in its earlier days, the Library of the Department is now a unified system consisting of the main Library and branch libraries in the various bureaus and offices. The branch libraries are special working collections on the subjects with which the various bureaus and offices deal. All have librarians and assistants in charge of them who specialize in the reference and bibliographical work in the subjects of special interest to the bureaus and offices with which they are respectively connected.

The work of the main Library is divided into four main divisions, (1) the Readers' Division, which includes the reference and circulation work; (2) the Catalogue Division, which classifies and catalogs the accessions to the Library; (3) the Periodical Division, which acquires

and circulates the periodicals and other serials; and (4) the Business Office. The order work is divided between the Catalogue Division and the Periodical Division, the chief of the Catalogue Division having charge of the ordering of the books and the chief of the Periodical Division having charge of the ordering of the periodicals. In the main Library are filed, with certain exceptions, the reference collections, the publications of more general interest to all the bureaus, and likewise the older and less used material.

SCOPE

Following is a detailed description of the scope of the Library as a whole, including both the general and the special subjects covered by its collections.

On the general subject of agriculture and all of its branches, such as plant and animal industry, dairying, and veterinary science, the Library's collections are extensive, and include not only books, periodicals, and society publications but also what may be termed the official agricultural literature. No other collection in this country is so strong in local, State, and national official agricultural publications of the United States. Similar foreign publications are comprehensively represented.

Statistical publications relating to agriculture have been collected practically from the very beginning of the Library, but in the past 20 years the literature of the broader subject of agricultural economics has rapidly increased, and in this general subject the Library is now especially strong.

Although the Bureau of Plant Industry draws upon nearly every class of scientific literature, its interests are, broadly speaking, botanical, and in this field the Library collections are noteworthy. They include the essential working books of systematic botany and an extensive collection of periodical and society publications relating to botany. A somewhat unusual feature is a collection of more than 50,000 horticultural trade catalogs.

The chemistry collections contain the important up-to-date books in inorganic, physical, pharmaceutical, and food chemistry, the food laws of various countries, and an extensive collection of chemical periodicals. The collections needed by the Bureau of Biological Survey include periodicals dealing with all phases of the study of birds, mammals, reptiles, and amphibians; fur farming and fur industry; game preservation; and the importation of wild life. The collection of periodicals on conservation and the extensive collection of game laws are also worthy of special mention. The collection on entomology is one of the best working collections on the subject in the United States. It is particularly strong on the economic side. Other major collections relate to forestry and lumbering, and to roads and agricultural engineering, including irrigation and drainage, farm buildings, farm equipment, and rural sanitation. In the Bureau of Home Economics the Library is building up a collection of publications on the problems of the home, including foods, nutrition, textiles and clothing, and housing and equipment. The Weather Bureau library contains about 50,000 volumes and is the largest single collection of meteorological literature in the world.

Utility mainly determines the choice of books. Books are not purchased because of their rarity or beauty, unless they have also a scientific or historical value to the Department. Nevertheless, the Library contains many rare books and periodicals. Full advantage is taken of the resources of other Government libraries, particularly the Library of Congress and the Surgeon General's library. Books which are available in other libraries in Washington are not duplicated unless needed for frequent consultation.

CATALOGS, INDEXES, AND BIBLIOGRAPHIES

The dictionary card catalog of the library, the greatest single source of information on the literature of agriculture and the related sciences, now contains three quarters of a million cards and is a record of the book resources of the whole Department with the exception of the collections of the Weather Bureau. This dictionary catalog also contains printed cards for books of interest to the Department which are available in the Library of Congress and other Government libraries. In the special subjects of prime concern to the various bureaus the general catalog of the library is supplemented by more detailed special catalogs and indexes on various subjects prepared in large part by the bureau libraries.

Supplementing the general and special catalog and the special indexes of the libraries are bibliographies and lists which have been prepared both by the main library and the bureau libraries. Most of these are mimeographed. The series of Bibliographical Contributions issued by the Department Library numbers 23 to date. In a series of Agricultural Economic Bibliographies issued by the Bureau of Agricultural Economics library, 48 numbers have been issued. In addition to the bibliographies included in these series, there are separate bibliographies issued by the libraries of the various bureaus and offices.

Another type of bibliographical service furnished by the various libraries of the Department is the regular issuance of mimeographed lists of current literature. These are as follows: The Bureau of Agricultural Economics library publishes monthly Agricultural Economics Literature which abstracts as well as lists the material. The Division of Cotton Marketing library of the Bureau of Agricultural Economics publishes monthly Cotton Literature: Selected References. The Bureau of Agricultural Engineering library issues monthly Agricultural Engineering Current Literature, and the Bureau of Entomology issues bimonthly Entomology Current Literature. The Forest Service library issues bimonthly Forestry Current Literature. The Bureau of Plant Industry library publishes two biweekly lists called respectively Agronomy Current Literature, and Botany Current Literature. The Bureau of Public Roads library issues weekly Highways Current Literature. The Office of Experiment Stations library compiles various lists of State experiment station and State extension literature. The Official Record of the Department, until its discontinuance in July 1933, contained each week a list of the principal accessions to the Department Library. Since its discontinuance the Department

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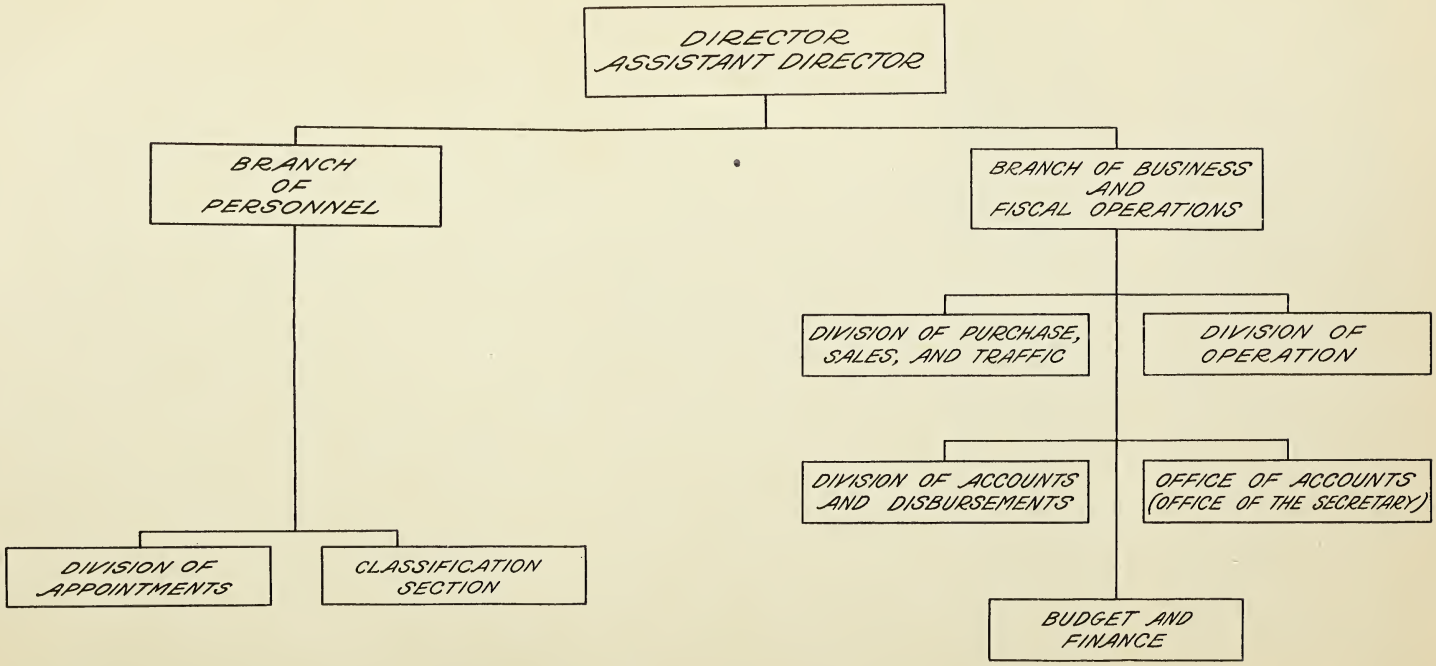
Library has issued a mimeographed monthly called Agricultural Library Notes containing lists of principal accessions to the Department Library, and several other lists which were formerly published in the Official Record. These various current lists aid the Department workers in keeping informed about new material on their various subjects. They are also being increasingly used by investigators outside the Department. The Experiment Station Record also serves as an index to the Department Library, since most of the books and periodicals abstracted in the Record are contained in the library.

USE

While the library is first of all for the benefit of the Department, it is free for reference to any who wish to use it. Books needed in research work are lent to libraries and institutions in every State of the Union, particularly to the various State agricultural colleges and experiment stations. The library also aims to serve as a center of bibliographical information relating to the literature of scientific agriculture.

OFFICE OF PERSONNEL AND BUSINESS ADMINISTRATION



OFFICE OF PERSONNEL AND BUSINESS ADMINISTRATION

In 1925 the Secretary of Agriculture consolidated nine separate and independent business and personnel offices into the centralized Office of Personnel and Business Administration, under the leadership of a director. It was the purpose of this centralization to eliminate confusion and waste in business procedure and to simplify and facilitate the general business administration of the Department.

The field activities of the Department, as well as the work in Washington, come before this Office so that the personnel and business phases may be coordinated. Approximately 8,623 employees are working in the District of Columbia, while 24,125 are working at 1,451 field stations scattered throughout the United States, and 80 stations in foreign countries.

The Office of Personnel and Business Administration is organized into two major units—the Branch of Personnel and the Branch of Business and Fiscal Operations.

This Office represents the Department in dealing with the Civil Service Commission, the Employees' Compensation Commission, the Bureau of the Budget, the General Accounting Office, the Veterans' Administration.

In personnel administration, organization, budget, and fiscal matters this Office cooperates with bureau chiefs and other officials of the Department. It purchases needed equipment and sells unneeded materials. It handles problems connected with the official travel of members of the Department, and with the transfer of necessary supplies between headquarters and the field. It provides suitable working quarters for the Department's personnel.

On February 2, 1931, the Secretary designated the Director of Personnel and Business Administration, the executive secretary to the director, and the Department real-estate officer as a committee to plan housing and property-utilizatiton for the Department. A primary consideration was the possibility of consolidating suburban stations near Washington. There are 3 such stations in Virginia and 8 in Maryland, all within commuting distance of headquarters.

The committee, advisory in character, devotes its time to fact-finding and planning. Its activities and those of the real estate office are interrelated.

BRANCH OF PERSONNEL

The Branch of Personnel, functioning immediately under the Director of Personnel and Business Administration, is composed of two distinct types of work: the Division of Appointments and the Classification Section. The Division of Appointments, is responsible for the personnel changes of the Department insofar as such changes are affected by civil-service rules, by the Retirement Act, and its

amendments, by administrative and fiscal regulations, or by decisions of the Comptroller General. It acts as contact office with the Civil Service Commission and the Retirement Subdivision of the Veterans' Administration. The Division has a complete service record of 32,828 employees and compiles personnel statistics as required. It maintains cumulative records of appointments, reports on probationers, promotions, demotions, resignations, removals, retirements, leave, and furloughs without pay. It assists in developing tests and examinations for applicants for positions in the Department.

The Classification Section deals with the allocation of specific types of work to certain services and grades according to the provisions of the Classification Act of 1923 and its amendments. It conducts investigations and surveys involving the positions of employees throughout the Department, and makes recommendations to the Director concerning appropriate classification grades. It acts as contact office with the Personnel Classification Division of the Civil Service Commission. Incidental to the classification work it is necessary for this Office to study organization set-ups of the several bureaus and offices and to analyze and describe bureau functions. It considers proposed changes of departmental organizations and the effects these changes will have on the work and the classification grades concerned. It also prepares and maintains personnel organization charts of all bureaus and offices of the Department.

BRANCH OF BUSINESS AND FISCAL OPERATIONS

The Branch of Business and Fiscal Operations, under the general supervisioin of the Assistant Director and Budget Officer, comprises the Division of Accounts and Disbursements, the Division of Purchase, Sales, and Traffic, the Division of Operation, and the Office of Accounts for the Office of the Secretary.

The Assistant Director and Budget Officer supervises the preparation of the Department's estimates of financial needs and their presentation before the Bureau of the Budget and the Appropriation Committees of Congress and serves as the Department's general contact officer with these agencies. He exercises general oversight over the business and fiscal affairs of the Department. This involves the allotment and apportionment of appropriations, questions of general policy dealing with expenditures, legislation involving expenditure of funds, accounting, and other procedure involving action by the General Accounting Office.

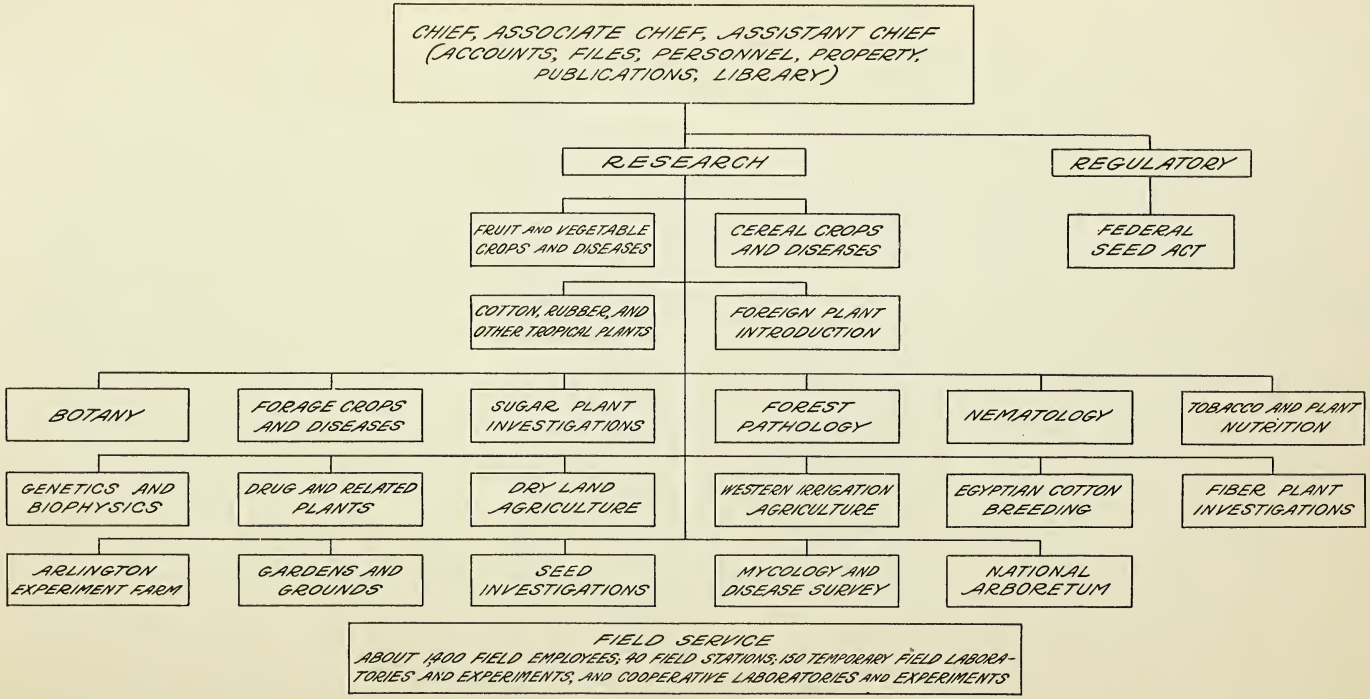
The Division of Accounts and Disbursements maintains the central departmental appropriation ledgers and records of receipts and expenditures, provides all bureaus with periodical statements of balances, and affords technical advice to the special temporary disbursing agents of the Department. It includes the main disbursing office of the Department wherein all funds are disbursed and all receipts collected for the Department except those handled by the fiscal agents of the Forest Service and the special disbursing agents. This division also handles, in conjunction with the budget officer, the compilation of the detailed estimates of appropriations.

The Division of Purchase, Sales, and Traffic coordinates the purchase, property, sales, and traffic work of the Department. It solicits and accepts bids for the Department's procurement of a large percentage of the Department's material, supplies, and services, and supervises the operation of the Department's central supply sections, the main distributing point of supplies in the District of Columbia. It serves as a clearing house for the interchange of surplus property between bureaus of the Department, and between this and other departments. The traffic section of the Division is responsible for the routing of all departmental equipment and supplies in a manner affording the most economical transportation, and for estimates of shipping costs where they are a factor in determining the lowest bid for material to be purchased. It assists the personnel with its passenger-transportation problems, and provides freight- and passenger-rate information to the Department's auditors.

The Office of Accounts for the Office of the Secretary maintains the operating accounting records for the Office of the Secretary, the Extension Service, the Office of Experiment Stations, the Office of Information, and the Grain Futures Administration. These records are to be distinguished from the general departmental accounting records maintained in the Division of Accounts and Disbursements.

The Division of Operation includes the various operating facilities formerly included in the office of the Chief Clerk. These comprise real estate and housing; control of expenditures and preparation of the budget for the Office of the Secretary; mail, files, and post office; telegraph and telephone; personnel work for the Office of the Secretary; and emergency room. The administration of the buildings in Washington (except the Weather Bureau group) has been transferred to the Department of the Interior, but the chief of the Division of Operation generally supervises conditions and serves as the contact officer in dealing with the Department of the Interior in matters pertaining to building administration.

BUREAU OF PLANT INDUSTRY



BUREAU OF PLANT INDUSTRY

The activities of the Bureau of Plant Industry are primarily in the field of research, including the corollary experimental work in laboratory and field. The Bureau strives to lessen the waste of effort, time, and money that results from ignorance or disregard of the biological facts and processes involved in plant growth and plant utilization.

At the present time the Bureau is acquiring land in the District of Columbia on which to establish and maintain a National Arboretum.

CONTRIBUTIONS TO ECONOMIC PROGRESS

The most numerous and perhaps the most significant of the Bureau's contributions toward the Nation's economic progress, have been the establishment of new industries, the introduction of new plants, the development of new methods of plant culture or handling, the control of plant diseases, and other new ideas involving plant science. Widely varied research is conducted in the fields of agronomy, horticulture, physiology, biochemics, genetics, and technology with special reference to cereal and forage crops; to drug, sugar, rubber and fiber plants; to cotton and tobacco; and to fruits, vegetables, nuts, and other economic crop plants. Particularly with fruits and vegetables, the return to the grower depends upon improved methods of harvesting, handling, shipping, and storing for market purposes as well as upon satisfactory methods of field production. Accordingly, for a considerable period, investigations have been directed toward a clearer understanding of the behavior of fruits and vegetables under different conditions of handling, storage, and utilization. The Bureau's work also includes crop improvement by breeding and selection; experimentation in culture and rotation methods adapted to irrigation, dry-land, and other systems of agriculture; arboricultural investigations and experiments with special reference to erosion-control planting activities; and the identification of fungi, bacteria, nemas, or viruses causing plant diseases and the development of methods for their control. Problems connected with the quality and germination of field seeds are investigated and the Federal Seed Act is enforced, requiring sampling of importations of field seeds, coloring of red clover or alfalfa seed of foreign origin and, regardless of origin, establishing penalties on misbranding and adulteration of seed in interstate commerce.

NEW PLANTS

Plant material for use in breeding work is being secured not only through study of that already in this country but also in special cases through foreign exploration and study of the crops in the regions where they are native and are obtainable in more primitive

form than elsewhere. The bringing together of promising plants from other parts of the world is in fact one of the very important functions of the Bureau. Through this means the basis of our agriculture is steadily being broadened both by securing improved types of plants suited to immediate adoption for quantity production and through affording the necessary material for use of the plant breeders of the country. The important Egyptian cotton industry of the Salt River Valley of Arizona is a direct result of such work, and many of our leading varieties of lespedezas, wheat, oats, soybeans, sorghums, grasses, and other staple crops trace directly or indirectly to this type of work.

Among the first of the major activities of the Bureau was the study of foreign cereals and the selection and introduction of certain important varieties for trial in the United States. The first introduction of a new grain upon a large scale was the establishment of the durum varieties of wheat, which are adapted to certain of the more severe climates of the United States where the varieties of wheat previously grown were unsuited. Hazards in wheat production under dry-land conditions have been much reduced by the introduction of hard red winter wheats from Russia and by the development therefrom of improved pure lines or hybrids such as Kanred, Oro, Regal, and Newturk.

COTTON-PRODUCTION STUDIES

As a result of intensive studies of cotton-production problems in the United States by specialists of the Bureau, superior varieties of cotton have been bred, while others have been discovered and introduced from abroad and developed in this country, including such varieties as Acala, Lone Star, Columbia, Trice, Foster, Express, Durango, Meade, and Pima. The Acala cotton, a superior upland variety producing a premium staple, was discovered in 1906 in a remote region of southern Mexico by an expedition sent out by this Bureau. In was introduced, selected, and established in cultivation in the United States. With the exception of a small acreage of the Pima Egyptian cotton in the Salt River Valley of Arizona, practically the entire irrigated cotton area of western Texas, New Mexico, Arizona, and California is now producing Acala cotton. The Acala cotton is also being grown on hundreds of thousands of acres in the natural rainfall districts of Texas, Oklahoma, and Arkansas.

FUNDAMENTAL RESEARCH

In common with other agricultural research institutions in this country and abroad, it has been the experience of the Bureau of Plant Industry since its inception that the problems eventually of the greatest value to agriculture are those dealing with fundamental research. The outstanding example of projects of this character at the present time is the biological influence of light, as indicated by the determinative effect on plant growth of different lengths of day, upon different species and varieties of plants. The importance of this relationship is shown by the revolutionary discovery that the maximum length of the summer day is the deter-

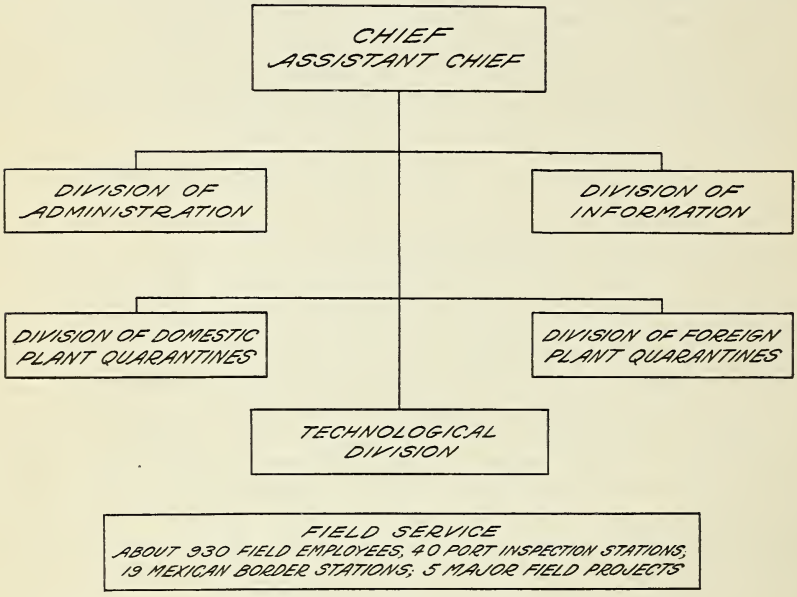
mining factor in the distribution of many species of wild plants in the temperate and tropical regions. This information is now being utilized in more satisfactory planning of the experimental regions for different new cultivated plant varieties. The accurate, prompt placing of new varieties of small fruits such as strawberries, the more satisfactory control of the blooming periods with resultant improvement in the opportunities for breeding and selection of new varieties, and the selection of areas for seed production of certain crops are a few of the immediately practical advantages dependent on the discovery of the length-of-day reaction.

Increased yield per plant or per unit of area has not usually been a primary objective in fruit breeding, but, rather, the development of varieties which are superior in some particular to existing sorts, or are better suited for certain purposes, or which will extend the range of adaptability of the fruit to other regions. Thus the Van Fleet raspberry, developed by breeding, adds to the list of raspberry varieties a new sort that not only is normally much more productive than the standard sorts but is adapted for home use to a large region south of that in which ordinary red raspberry varieties are successful and which extends into northern Florida.

DEVELOPMENT OF DISEASE-RESISTANT VARIETIES

The control of plant diseases by the development of protective-cultural practices, new spray materials, or other methods, especially when major crops are involved, has always been one of the principal phases of the Bureau's activities. Some plant diseases are most effectively fought through the discovery or breeding of varieties immune or resistant to them. To the extent that it is possible to combine disease resistance with the special qualities for which the plant is grown, this is the obviously sound line of procedure, for the protection of susceptible plants against parasitic organisms through sprays, dust, or other methods obviously increases the cost of their production. To forward this work, the Bureau of Plant Industry has under way a number of plant-breeding projects that aim to produce crop plants possessing desirable qualities for growth in particular regions, in combination with resistance to the diseases that have been found most troublesome and expensive to control. Among such may be mentioned the breeding of pears resistant to pear blight; chestnuts resistant to blight; peaches resistant to brown rot; tomatoes resistant to wilt; wheat resistant to rosette, rust, and other diseases; flax resistant to wilt; sugar beets resistant to curly top; and sugarcane resistant to mosaic. This last-mentioned disease, during the last decade, has attracted world-wide attention and has been the subject of investigations in 22 cane-producing countries. The Bureau has introduced into the United States new varieties of sugarcane that have proved to be resistant to the mosaic, and the cultivation of these varieties has rehabilitated the sugarcane industry in Louisiana.

BUREAU OF PLANT QUARANTINE



BUREAU OF PLANT QUARANTINE

The Bureau of Plant Quarantine is responsible for the enforcement of quarantines or regulations promulgated to prevent the entry into or dissemination within the United States of dangerous plant pests new to or not widely distributed in this country. It is also responsible for carrying on, in cooperation with the States, necessary work to prevent the spread or to eradicate pests that may have gained local foothold. It has been estimated that farm, fruit, and other pests introduced from abroad cost the United States more than a billion dollars a year. About 2 hours of every day's work on the farm or in the garden and orchard are required to produce the food that these uninvited guests eat.

To accomplish these objects various laws have been enacted providing for the restriction or the regulation of movement of products likely to carry pests. Four acts of Congress make provision for quarantine or other regulatory action. They are: The Federal Plant Quarantine Act of 1912, the act providing for Mexican border inspection and control service, the Insect Pest Act of 1905, and the Terminal Inspection Act of 1915 (in cooperation with the Post Office Department).

In addition to these duties the Bureau is responsible for the enforcement of the Export Certification Act. This act, as an aid to exporters, authorizes the issuance of certificates to meet the sanitary requirements of foreign countries, and provides for inspection and certification as to freedom from injurious insect pests or plant diseases of fresh fruits and vegetables, plants, etc., intended for export.

HISTORICAL REVIEW

The Plant Quarantine Act was the culmination of several years of effort to have some type of legislation passed by Congress that would make possible the protection of the agriculture and horticulture of the United States from the introduction and spread of foreign plant pests. The act was approved August 20, 1912, and the quarantine provisions of section 7 (the foreign section) became immediately effective so far as they applied to the white pine blister rust, potato wart, and the Mediterranean fruit fly. With this exception the act did not become effective until October 1, 1912.

The act specified that there should be appointed by the Secretary of Agriculture from existing bureaus and offices in the Department of Agriculture, including the Bureau of Entomology, the Bureau of Plant Industry, and the Forest Service, a Federal Horticultural Board consisting of 5 members, of whom not more than 2 should be appointed from any 1 bureau or office, and who should serve without additional compensation. This Board was appointed August 21, 1912, by Secretary James Wilson.

Following the holding of the public hearings required under the act, quarantines on account of the white pine blister rust, the Mediterranean fruit fly, and the potato wart were promulgated September 16, September 18, and September 20, 1912, respectively. Quarantines on account of the gypsy moth and brown-tail moth, the Mexican fruit fly, date-palm scale insects, and the pink bollworm of cotton followed in rapid succession.

The rules and regulations governing the entry of nursery stock into the United States have been revised many times. They were originally issued September 18, 1912, as Circular No. 41, Office of the Secretary, under the title "Rules and Regulations for Carrying Out the Plant Quarantine Act", and applied only to "woody plants and parts thereof for propagation or planting." On May 21, 1913, these regulations were revised and issued as Circular No. 44, Office of the Secretary. On June 23, 1914, they were again revised and issued as "Rules and Regulations under the Plant Quarantine Act: General, including Nursery Stock." On April 15, 1916, there was a further revision issued as Rules and Regulations Governing the Importation of Nursery Stock into the United States. On November 18, 1918, Quarantine No. 37, with regulations (nursery stock, plant, and seed quarantine, effective on and after June 1, 1919), was issued, and, as since amended, is still in effect.

This quarantine and supplemental regulations superseded the rules and regulations theretofore enforced governing the entry of nursery stock, and brought under restriction all other plants and plant products for or capable of propagation. The regulations provide for the entry without permit of field, vegetable, and flower seeds. Rose stocks, certain bulbs, nuts, and tree seeds may be imported under permit in unlimited quantities from countries which maintain inspection. All other plants may be imported only under special permit in limited quantities for the purpose of keeping the country supplied with new varieties and necessary propagating stock, or for any necessary experimental, educational, or scientific purpose.

QUARANTINES NOW IN FORCE

At the present time, as later outlined, there are in force 24 foreign quarantines and restrictive orders and 19 domestic quarantines. Nine quarantines have been revoked. Three of these were on account of the powdery scab of potato (one foreign and two domestic) and the others on account of the Mexican bean beetle, Canadian Christmas trees and greens, Asiatic beetles, the Mediterranean fruit fly, the European corn borer, and the phony peach disease.

The act making appropriations for the Department of Agriculture for the fiscal year 1929 provided that the functions of the Federal Horticultural Board, under the Plant Quarantine Act, should devolve upon and be exercised by the Plant Quarantine and Control Administration. Provision was also made in the appropriation act referred to for an advisory Federal Plant Quarantine Board of five members, the Chief of the Administration to serve ex officio as chairman, and the four additional members to be designated by the Secretary of Agriculture from existing bureaus and offices of the Department, including the Bureau of Entomology, the Bureau of Plant Industry, and the Forest Service, all to serve without addi-

tional compensation. This change became effective July 1, 1928, at which time the portion of the insect and plant disease quarantine and related control work, formerly assigned to the Bureaus of Entomology and Plant Industry, was taken over by the Plant Quarantine and Control Administration.

Effective July 1, 1932, under the authority of the act making appropriations for the Department of Agriculture for the fiscal year 1933, the Plant Quarantine and Control Administration was superseded by the Bureau of Plant Quarantine. The advisory Federal Plant Quarantine Board, referred to in the preceding paragraph, was abolished by the act making appropriations for the Department of Agriculture for the fiscal year 1934, effective July 1, 1933.

QUARANTINES AGAINST FOREIGN PESTS

Under the Plant Quarantine Act 24 quarantines and restrictive orders prohibiting or regulating the entry of foreign plants and plant products are now enforced. These are intended to exclude injurious pests which either do not occur in the United States or have at present a limited distribution. Among the pests (insects and plant diseases) are citrus canker, white pine blister rust, potato wart, bamboo smut, flag smut of wheat, downy mildew and leaf smut of rice, apple cankers and rusts, pink bollworm of cotton, banana weevils, sweetpotato and yam weevils, European corn borer, Mediterranean and other fruit flies, brown-tail moth, gypsy moth, oriental fruit moth, sorrel cutworm, European lackey moth, gold-tail moth, citrus blackfly, Dutch elm disease, and others.

Provision is made for the entry under permit of certain plants, cereals, fruits, vegetables, cotton, burlap, and so on, believed to carry a negligible pest risk, at ports designated in the permits, subject to inspection and, if necessary, disinfection. Plants entered under special permit—i.e., plants imported for propagation, experimental, educational, or scientific purposes, and not for immediate or ultimate sale—are examined at Washington and subsequently reexamined in the field, by agreement with the growers. All other plants and all plant products imported under permit are inspected by inspectors or collaborators of the Bureau of Plant Quarantine at the port of first arrival or entry.

In an effort to prevent the entry of prohibited plants and plant products, the Bureau of Plant Quarantine representatives stationed at the more important ports of entry, in addition to enforcing the entry requirements on commercial importations, are charged, in cooperation with the Treasury and Post Office Departments, with the inspection of passengers' baggage, crews' quarters, ships' stores, and foreign parcel-post packages. Passengers' baggage arriving from foreign countries by airplane is similarly inspected.

MEXICAN BORDER ACT

A few years after the passage of the Plant Quarantine Act, a severe outbreak of the pink bollworm of cotton, perhaps the worst pest of that important plant, was discovered in the so-called Laguna region of Mexico. The grave danger of the entry of this insect into the United States with railway cars, freight, express, baggage,

and other materials from Mexico, was at once recognized. As the provisions of the Plant Quarantine Act did not fully meet this situation, the matter was presented to Congress with a request for additional authority. The outcome was the inclusion of the so-called Mexican Border Act in the Department of Agriculture Appropriation Act for the fiscal year 1918, and its repetition each year thereafter. This act supplements the Plant Quarantine Act of 1912 by giving additional powers with respect to the control of the movement of railway cars and other carriers entering the United States from Mexico. As a condition of entry, all freight cars are inspected in the freight yards of the Mexican town opposite the American port of entry, and as an additional precaution such cars are fumigated on crossing the border.

This service also enforces all quarantines and restrictions which relate to the entry of Mexican plants, fruits, vegetables, cereals, cottonseed cake, and other products. Inspectors are stationed at the more important points on the Mexican border.

QUARANTINES RESTRICTING THE INTERSTATE SPREAD OF PESTS

There are now in force 19 domestic quarantines controlling the interstate movement of plants and plant products and of certain other materials likely to carry plant pests. Eleven of these quarantines relate largely to shipments within the continental United States, and 8 are confined to movements between Hawaii or Puerto Rico and the mainland.

The plant quarantines relating to the continent are intended to prevent the spread within the United States, and, in certain instances, to effect the eradication of plant and forest enemies which have recently reached this country and have limited distribution here. Examples are the gypsy moth, the brown-tail moth, the satin moth, the pink bollworm of cotton, the Mexican fruit worm, the Japanese beetle, the date-palm scale, and certain plant diseases such as white pine blister rust, and black stem rust of wheat and other cereals. A quarantine restricting the movement of Florida fruits to prevent the spread of the Mediterranean fruit fly was in effect from May 1, 1929, until November 15, 1930, during the progress of the fruit-fly-eradication work there. This quarantine was revoked after it became apparent that the eradication work had been so successful that scouts were no longer able to find Mediterranean fruit flies in the State, and it is hoped that the pest has been completely eradicated from the United States.

The Federal quarantines have been particularly effective in preventing the spread of the Parlatoria scale on date palms, the gypsy moth, the brown-tail moth, the Mediterranean fruit fly, the Thurberia weevil, and the Mexican fruit worm. These insects depend for transportation to new localities to a large extent on the carriage of infested products, and quarantines are especially effective in regulating their movement.

Certain types of pests and diseases, however, have means of spreading that cannot as yet be controlled. The object of establishing domestic plant quarantines with respect to the movement of such pests as the Japanese beetle and the white pine blister rust is to

retard their spread and to prevent the establishment of new centers of infestation. It is possible to investigate methods of preventing injury from the pests, to inform the public about control measures and in certain cases initiate such measures before a pest arrives, and to introduce parasites if the pest is an insect, or to develop resistant varieties or adopt sanitation measures if the pest is a plant disease. Methods used for the enforcement of plant quarantines include the inspection of plants and plant products inside the infested area to insure their freedom from infestation, the fumigation, disinfection, or other treatment of susceptible plants which are to be shipped from infested to noninfested sections of the country, the establishment of road stations to prevent the transportation of infested products by highway vehicles, and the checking of express, parcel post, and freight to insure compliance with the quarantine requirements on the part of shippers of plants and plant products susceptible to infestation.

ACTION BY STATE AUTHORITY

Eradication measures against certain pests that are the subject of domestic plant quarantines are undertaken by the Federal Government in cooperation with and under the direct authority of the States concerned. Such efforts have been successful in the eradication of the pink bollworm of cotton in an extensive area involving a number of counties in the Trinity Bay district of Texas and several adjoining parishes in southwestern Louisiana, as well as a number of isolated local outbreaks in other parts of the same States; in stamping out gypsy-moth infestations in Cleveland, Ohio, in North Castle, Brooklyn, Greenport, and Geneva, N.Y., and in Loretto, Pa., and in the approaching total eradication of an extensive infestation of this pest in northern New Jersey.

OTHER LAWS ENFORCED BY THE BUREAU

The Export Certification Act provides for the inspection and certification of fresh fruits, vegetables, seeds, and nursery stock and other plants for propagation when offered for export to meet the sanitary requirements of foreign countries. Inspectors are stationed at the more important ports of export.

The Insect Pest Act of 1905 is enforced by inspectors stationed at the various ports of entry in cooperation with officials of the Treasury and Post Office Departments. It prohibits the importation or interstate transportation of insect pests and the use of the United States mails for that purpose, except under regulations prescribed by the Secretary of Agriculture.

The Terminal Inspection Act of 1915, enforced in cooperation with the Post Office Department, provides under certain conditions for the inspection at destination of plants and plant products transmitted through the mails. California, Arizona, Montana, Florida, Washington, Arkansas, District of Columbia, Mississippi, the Territory of Hawaii, Utah, Oregon, Georgia, Idaho, Oklahoma, Wyoming, Louisiana, and the Territory of Puerto Rico, in the order named, have availed themselves of the provisions of this act, although the States of Idaho, Wyoming, and Georgia subsequently found it neces-

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sary to discontinue such inspection. While this inspection is conducted entirely at the cost of the States concerned, it results in the detection of numerous uncertified or prohibited shipments of articles mailed in violation of Federal domestic-plant quarantines. Senders of such parcels are usually ignorant of the quarantine restrictions. The terminal inspection is thus of great value in the enforcement of these quarantines.

TECHNOLOGICAL DIVISION

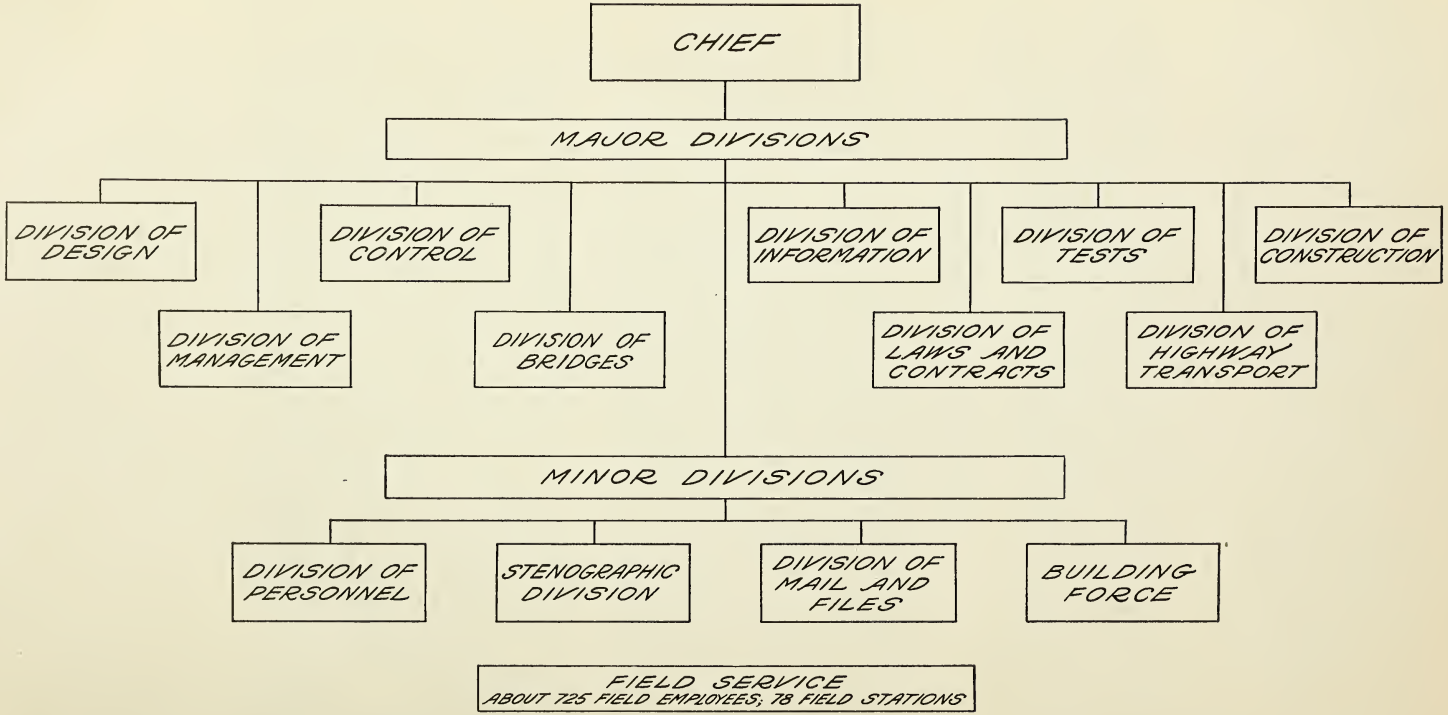
This organization is concerned with the commercial application of the findings of the research bureaus of the Department to the disinfection and sterilization of plants and plant products moving under the various foreign and domestic quarantines, and with the improvement and standardization of methods now followed by the Bureau of Plant Quarantine in the sterilization and disinfection of these products.

QUARANTINE MODIFICATIONS

The work of the Bureau of Plant Quarantine varies greatly from year to year, as the Bureau carries the responsibility for the suppression of new outbreaks of insect pests and the prevention of their spread to noninfested sections of the country. Prior to the passage of the Plant Quarantine Act of 1912, and to the issuance of foreign quarantine no. 37 in 1918, new insect pests and plant diseases were arriving in the United States with alarming rapidity. For example, during the period from 1908 to 1912, such new major pests as the oriental fruit worm, the Japanese beetle, the citrus canker, the potato wart, the European corn borer, and the camphor scale reached this country. The increase in the number of new pests was practically stopped by the enforcement of this law and the regulations issued under it.

Most of the pests and diseases which entered the United States before the passage of the Plant Quarantine Act have now become widely established and their further spread could not be retarded materially by domestic plant quarantines. The oriental fruit worm and the chestnut blight, concerning which no Federal domestic quarantines have been issued, are illustrations of that development. More recently introduced insects and diseases have in some cases apparently been exterminated or are approaching eradication. The present tendencies, therefore, are in the direction of gradually removing Federal restrictions on the interstate movement of plant material and of further strengthening the port-inspection service to reduce the danger of the introduction of foreign insects and plant diseases.

BUREAU OF PUBLIC ROADS



BUREAU OF PUBLIC ROADS

The Bureau of Public Roads is the agency of the Federal Government for the administration of Federal-aid road construction and emergency road construction financed with Federal Public Works funds. Federal-aid work has been carried on under the Federal-aid Road Act of 1916 as amended by the Federal Highway Act of 1921 and other amendments. In this work and the closely related work of improving the main roads of the national forests, the Bureau has in past years supervised an annual program of road construction ranging from 8,000 to 15,000 miles.

At present the Bureau is engaged, under direction of the Secretary of Agriculture and the Special Board of Public Works, in administering the appropriations made specifically for highway construction by the public works title of the National Industrial Recovery Act.

The Bureau is also an agency of highway research. Results of its investigations, conducted independently and in cooperation with State highway departments, universities, and engineering experiment stations, are applied directly for the improvement of its own large construction operations. They are applied also on thousands of miles of other road work. The improvements in road design and in the quality of highway materials made possible by the Bureau's researches are of direct benefit to all classes of road users.

CREATED IN 1893

Under the name of the Office of Road Inquiry, the Bureau was created in 1893 by the Secretary of Agriculture to carry out an act of Congress that appropriated $10,000 to enable the Secretary to make inquiries in regard to the systems of road management throughout the United States, to make investigations in regard to the best methods of road making, to prepare publications on this subject suitable for distribution, and to enable him to assist the agricultural colleges and experiment stations in disseminating information on this subject * * *.

From the date of its creation until 1912, the Bureau's functions were those of investigation and education only. During this period, the Bureau and a small but growing group of pioneer State highway departments redeemed the processes of road building from the depths of futility into which they had fallen in nearly a century of unintelligent direction, and laid the foundations of modern scientific highway construction.

The Post Office Appropriation Act for the fiscal year 1913 launched the Bureau upon a new career of responsible road building. The act provided an appropriation of $500,000 to be expended by the Secretary of Agriculture in cooperation with the Postmaster General for the improvement of post roads to be selected by them.

This initial experience in the administration of large construction expenditures was of great value to the Bureau when, as a result of the passage of the Federal-Aid Road Act, it was called upon to cooperate with the highway departments of the several States in a larger program.

FEDERAL AID FOR HIGHWAYS

The policy of Federal aid to the States was initiated by the Federal-Aid Road Act of 1916. This policy has been continued with minor amendments in the law from time to time and the important amendment of 1921 which provided for the Federal-aid highway system.

A feature of the legislation of 1916 of far-reaching importance was the requirement that each State, to share in the appropriation, must first establish a State highway department adequate in the opinion of the Secretary of Agriculture to cooperate with him in the administration of the improvements provided for. As a result of this requirement the principle of State control, long advocated by the Bureau, was finally adopted by all States.

The act contained other provisions, then novel, which have demonstrated their wisdom in the succeeding years. It prescribed a definite mathematical formula for the apportionment of the Federal appropriation among the States. It provided that the money was to be divided: one third in the proportion of the area of the States, one third in the proportion of their population, and one third in the proportion of their respective mileages of rural post roads and star routes. It limited the amount payable by the Government on any road to 50 percent of the cost and not more than $10,000 per mile ($15,000 per mile now authorized) exclusive of the cost of bridges more than 20 feet in span.

It gave to the States the initiative, subject to the approval of the Secretary of Agriculture, to determine the roads to be improved and the character of the improvement. And, after improvement, it demanded of the States that they assume the obligation of maintenance and provided means for insuring that the obligation would be carried out. In the Secretary of Agriculture it reposed the final authority to determine the adequacy of the improvements and to grant or withhold the Federal assistance accordingly.

In one respect this act was materially defective. It permitted too wide a dispersion of the Federal money, so that there could be no assurance of the completion of connected arteries in any reasonable time. This defect was corrected by the Federal Highway Act, approved November 9, 1921.

THE FEDERAL-AID SYSTEM

The Federal Highway Act retained all of the outstanding features of the earlier act, and added the important requirement that the Secretary of Agriculture and the several State highway departments should jointly designate a system of important interstate and intercounty roads limited to 7 percent of the country's total road mileage, to constitute the Federal-aid highway system, upon which all future Federal appropriations should be expended. This system, as desig-

nated to date, includes approximately 206,000 miles of road, of which, on June 30, 1933, about 108,000 miles were classified as improved with Federal aid.

By other amendments the maximum amount payable by the Federal Government has been increased to $25,000 per mile under certain conditions; the proportion payable by the United States in States where the area is more than 5 percent federally owned public land has been increased from 50 percent to 50 percent plus one half the percentage of public land in the particular State; the States have been required to match the Federal apportionments with funds under the direct control of their highway departments; and the maintenance provision has been strengthened.

The annual Federal appropriations authorized to be expended under the direction of the Bureau for various road purposes in recent years have exceeded $140,000,000. Of this amount, $125,000,000 has been for Federal-aid road construction and administration, of which 2½ percent is available for payment of administrative and research expense. The balance of 97½ percent, matched by at least an equal amount of funds supplied by the States, goes into actual road work. In recent years from 8,000 to 15,000 miles of Federal-aid road have been completed annually.

The last Federal-aid appropriation authorized was that for the fiscal year 1933. A small balance of previously authorized funds remains to be expended but much the larger part of the money now available is the sum provided by the National Industrial Recovery Act.

PUBLIC-WORKS ROAD CONSTRUCTION

Two appropriations were made specifically for emergency highway construction by the Recovery Act, one of not less than $400,000,000 to be expended for construction on the approved Federal-aid highway system, extensions of the system into and through municipalities, and on secondary or feeder roads; and the other of not less than $50,000,000 to be expended for construction of roads in the national forests and parks, Indian reservations, and public lands.

The larger appropriation has been apportioned among the 48 States and Hawaii and the District of Columbia, in accordance with a stipulation of the law which requires seven eights of the total to be apportioned in accordance with the method provided by the Federal Aid Road Act and one eighth in proportion to population.

Programs for the expenditure of the apportioned funds were drawn up by the State highway departments subject to the general requirements that not more than 50 percent should be expended on the Federal-aid highway system outside of cities, not less than 25 percent on extensions of the system into cities, and not more than 25 percent on secondary or feeder roads until provision has been made for the satisfactory completion of 90 percent of the original 7-percent Federal-aid system. It was also required that projects should be undertaken in at least 75 percent of the counties of each State.

Programs conforming to the Federal requirements have been drawn up and approved and construction work is now well under way.

The recovery surveys are being made and plans and specifications prepared by the State highway departments, and these departments also advertise and award contracts and directly supervise construction, all subject to the approval of the Bureau of Public Roads.

The primary purpose of the public works program is to increase employment. To this end the rules and regulations issued establish certain conditions respecting the selection of labor, wages, hours of employment, and the extent to which hand-labor methods must be employed. Procedure has been simplified to the greatest extent consistent with sound administration and everything possible has been done to insure the provision of a maximum amount of employment, properly distributed, at the earliest possible date.

Within 5 months of the passage of the National Recovery Act 4,000 Public Works highway projects have been approved and more than 3,000 have been awarded to contract or begun with day labor employed under the direct supervision of the highway departments. These projects have been properly selected and are being carried on in accordance with adequate plans and under skilled supervision.

CONSTRUCTION OF FOREST ROADS

Federal funds for the construction of forest roads and trails became available as a result of the Federal-aid Road Act of 1916. The act provided an appropriation of $1,000,000 per annum for 10 years to be—

> expended under the supervision of the Secretary of Agriculture, upon request of the proper officers of the State, Territory, or county for survey, construction and maintenance of roads and trails within or partly within the national forests when necessary for the use and development of resources upon which communities within and adjacent to the national forests are dependent.

Construction of forest roads proceeded under the authority of this act until the close of the World War when Congress, in order to provide employment for returned veterans, amended the Federal Aid Road Act and appropriated an additional $3,000,000 a year for 3 years for forest-road construction. This amendment which was approved February 28, 1919, authorized the Secretary of Agriculture to proceed in the survey, construction, and maintenance of forest roads and trails without cooperation of the local authorities provided the work was necessary for the proper administration, protection, and improvement of national forests or that the work was of national importance.

Responsibility for the survey, construction, and maintenance of forest roads authorized under these acts was delegated by the Secretary of Agriculture to the Bureau of Public Roads which developed an organization adequate to handle the work economically and efficiently.

The Federal Highway Act, approved November 9, 1921, provided an increase in the annual appropriations for forest roads and made provision for the designation and approval by the Secretary of Agriculture of two distinct classes of forest roads, namely, forest-development roads and forest highways, and established a basis upon which future appropriations should be apportioned for these two classes.

FOREST HIGHWAYS CLASSIFIED

Roads and trails of primary importance for the protection, administration, and utilization of national forests or for the use and development of the resources upon which communities with or adjacent to the national forests are dependent, were designated forest-development roads.

Roads of primary importance to the State, counties, or communities within or adjacent to the national forests were designated forest highways.

Appropriations for forest-road construction are divided between these two classes as follows: Fifty percent, but not more than $3,000,000 of the appropriation authorized for any year, is apportioned to forest-development roads and the balance of the appropriation is apportioned to forest highways.

The total of all funds authorized by Congress for expenditure in the construction of forest roads up to and including the fiscal year ended June 30, 1933, was $130,000,000. Forest-road work is now being carried on with $25,000,000 provided by the National Industrial Recovery Act.

After the passage of the Federal Highway Act the State highway departments of the States in which national forests are located made a study, in cooperation with the Bureau of Public Roads and the Forest Service, of the highway situation in the forest areas and designated a forest-highway system for each State. These systems have been approved by the Secretary of Agriculture, and consist of a total of 16,458 miles located in 28 States and in Alaska.

A study of the needs for roads of primary importance to individual forests was made by the Forest Service, and the system of forest-development roads, recommended by the Forester, has also been approved by the Secretary. This system includes all existing or proposed roads within or adjacent to and serving the forests and which are designated as forest roads by the Forester.

Responsibility for the prosecution of the work outlined in the forest-highway program is vested in the Bureau of Public Roads; and all work incidental to making surveys, plans, and estimates, and handling all details of construction is carried out by this organization. The Bureau also has supervision and control of all forest-development projects where the services of an engineering organization are required, or where the estimated cost of the work is $5,000 per mile or more.

FOREST HIGHWAY MILEAGE

A total of 5,590 miles of forest highways has been constructed to June 30, 1933. At that time projects with a total length of 1,067 miles were under construction.

Maintenance of forest highways is undertaken by the Federal Government for a period of 2 years after construction in order to assure the integrity of the work during the period of most rapid deterioration and by the State or county thereafter. Frequent inspections are made by the Bureau of Public Roads to insure adequacy of maintenance.

NATIONAL PARK ROADS

Closely allied with the work in the national forests is work carried on by the Bureau under agreement with the National Park Service of the Department of the Interior. The Bureau acts as the engineering agency of the Park Service in the survey and construction of important highways in the great national playgrounds.

HIGHWAY RESEARCH

To solve the numerous technical problems that are constantly arising in its construction work and to extend the frontiers of the science of highway engineering, the Bureau carries on a program of highway research, the most comprehensive of its kind under any single agency, independently and in cooperation with the State highway departments, with universities, and with other agencies.

In carrying out its investigations, the Bureau makes use of both intensive laboratory analyses and tests, and extensive experiments and observations, the latter involving large sections of specially constructed test roads, actual roads in all parts of the country, and entire road systems of States and counties.

In addition to its laboratories for routine testing at the headquarters office in Washington, the Bureau maintains other laboratories for experimental purposes at the experimental farm of the Department of Agriculture at Arlington, Va. At the latter location it also has a large outdoor testing ground where road surfaces of various kinds are tested under controlled traffic, where the effects of climatic and vehicular forces are investigated, and where much of the important work of subgrade soil investigation is carried on.

DETERMINING SOIL CHARACTERISTICS

At Arlington, work is in progress looking to the development of simple tests which may be applied to different soils for the purpose of identifying their characteristics and probable behavior under various climatic conditions. This work also includes a study of the effects of the various elementary soil constituents upon the behavior of composite soils in which they are present in varying amounts.

When the samples of subgrade soil taken in the investigations of road failures are received at the laboratory, they are subjected to the tests that have been devised, and the results are studied in relation to the known conditions of the soil in the road.

ORGANIZATION

To carry out these various lines of work, the bureau has a headquarters organization at Washington, headed by the Chief of Bureau. The chief engineer has charge of all Federal-aid road work. Advising and assisting the Chief of Bureau and the chief engineer in the Federal-aid administration, are staff divisions of design, construction, and bridges, each headed by a chief, with headquarters at Washington.

The Bureau has direct contact with State highway departments through its district organizations, of which there are 12, each in charge of a district engineer. Eleven of the districts include from

2 to 8 States. District no. 11 covers the territory of Alaska, where the only activity is forest-road construction. The Bureau also maintains in most of the States, as a part of the district organization and as a still more direct contact with highway departments, a State office under a responsible engineer who works in close cooperation with the highway department.

At San Francisco, there is a regional headquarters for the administration of Federal aid to the Western States, and for national-forest and national-park road work, under the direction of a deputy chief engineer, to whom the district engineers of the five western districts report.

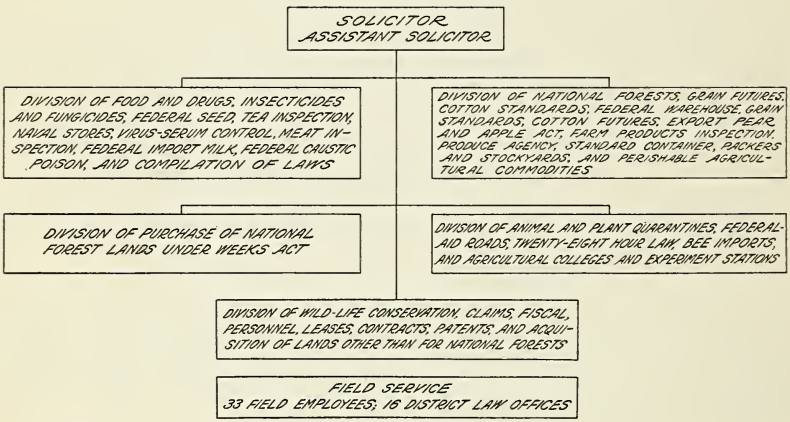
For the conduct of its research work, the Bureau has three divisions at Washington: The Division of Tests, which deals with the physical problems involved in the characteristics of road materials, and the forces of traffic and climate that affect road structure and design; the Division of Highway Transport, which deals with questions of highway finance, and the economics of highway service; and the Division of Management, which studies the economic aspects of road-construction processes with the object of reducing their cost and increasing their efficiency.

The Division of Control, which includes the accounting section, keeps the necessary control accounts showing the status of Federal aid. These records show, day by day, the status of all funds administered by the Bureau.

The legal division, in addition to its advisory functions in connection with administration of bureau activities, handles details of preparation and execution of contracts and of related matters pertaining to public works, Federal-aid and forest-road construction work, and also makes studies and gives advice concerning State and Federal highway legislation.

The Division of Information is the agency through which information is given to the public in various ways—through correspondence and bulletins, through exhibits, motion pictures and other means. The division is also responsible for the editing and publication of the bureau's research magazine, Public Roads.

OFFICE OF THE SOLICITOR


SOLICITOR
ASSISTANT SOLICITOR
DIVISION OF FOOD AND DRUGS, INSECTICIDES AND FUNGICIDES, FEDERAL SEED, TEA INSPECTION, NAVAL STORES, VIRUS-SERUM CONTROL, MEAT INSPECTION, FEDERAL IMPORT MILK, FEDERAL CAUSTIC POISON, AND COMPILATION OF LAWS
DIVISION OF NATIONAL FORESTS, GRAIN FUTURES, COTTON STANDARDS, FEDERAL WAREHOUSE, GRAIN STANDARDS, COTTON FUTURES, EXPORT PEAR AND APPLE ACT, FARM PRODUCTS INSPECTION, PRODUCE AGENCY, STANDARD CONTAINER, PACKERS AND STOCKYARDS, AND PERISHABLE AGRICULTURAL COMMODITIES
DIVISION OF PURCHASE OF NATIONAL FOREST LANDS UNDER WEEKS ACT
DIVISION OF ANIMAL AND PLANT QUARANTINES, FEDERAL-AID ROADS, TWENTY-EIGHT HOUR LAW, BEE IMPORTS, AND AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS
DIVISION OF WILD-LIFE CONSERVATION, CLAIMS, FISCAL, PERSONNEL, LEASES, CONTRACTS, PATENTS, AND ACQUISITION OF LANDS OTHER THAN FOR NATIONAL FORESTS
FIELD SERVICE
33 FIELD EMPLOYEES; 16 DISTRICT LAW OFFICES

OFFICE OF THE SOLICITOR

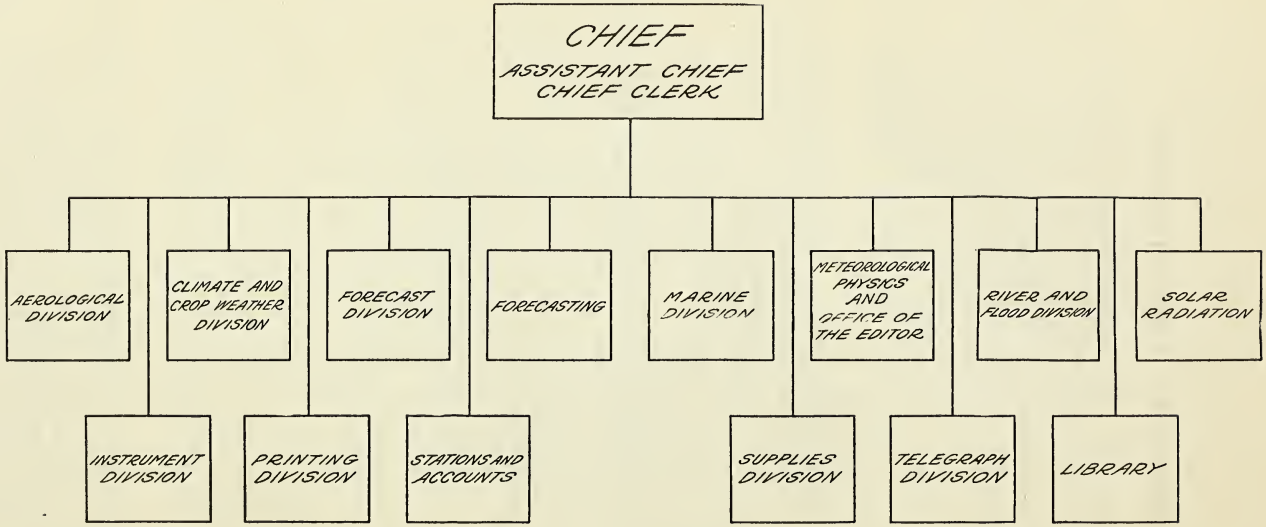
In the administration of the numerous laws enacted by Congress and the regulations promulgated thereunder relating to agriculture and allied subjects, legal questions and controversies of many kinds must necessarily be considered. By direction of Congress, the legal work of the Department is performed under the supervision and direction of the Solicitor, who acts as legal adviser to the Secretary and to the various administrative officers. The Solicitor is assisted by a corps of attorneys. The Office of the Solicitor has divisions which specialize in certain activities of the department. In this manner the Office seeks to be in a position to give expert advice on any legal question which may arise.

The office drafts proposed legislation and prepares legal papers of various kinds. It interprets laws enacted by Congress and aids in the preparation of numerous regulations and orders required for the effective administration of laws relating to the activities of the Department. It also conducts quasijudicial hearings under several of the Department's regulatory laws.

The Department of Agriculture, in the name of the United States, is party each year in thousands of legal controversies involving court procedure. Some of these involve the enforcement of civil rights or the redress of civil wrongs, in which respects the United States is comparable to individuals generally, while others are prosecutions for the violation of criminal statutes. Evidences of wrongs committed, obtained by representatives of the Department stationed over the country, are submitted to the Solicitor, who takes such action for the protection of the interests of the United States as the facts appear to justify. This involves a painstaking consideration of each matter presented and a determination of the facts as accurately as possible and the application of pertinent laws to these facts. When such action is warranted, a case is submitted to the Attorney General of the United States, with the recommendation that appropriate legal steps be taken. Aid is extended to the Department of Justice and to the various United States attorneys in the preparation and prosecution of the cases. The Solicitor also prepares and prosecutes applications for patents on behalf of employees of the Department in instances where their inventions may be used in the public interest.

Since the interests of the Department are very widespread, law officers under the supervision of the Solicitor are located at convenient points throughout the country in order that they may be in personal contact with representatives of the Department who may need their aid. Title attorneys also are located in various parts of the country to facilitate the acquisition of large areas of land utilized in the conservation policies of the United States.

WEATHER BUREAU



FIELD SERVICE
ABOUT 1,014 PERMANENT FIELD EMPLOYEES;
193 REGULAR WEATHER BUREAU STATIONS;
11 AIRPORT CENTERS AND 40 BRANCH AIRPORT
STATIONS; 2,337 PART-TIME EMPLOYEES; 4,900
COOPERATIVE STATIONS

THE WEATHER BUREAU

The Weather Bureau is primarily concerned with the furnishing of information of present, past, and future weather conditions over the land and sea. It renders such direct practical service as will best meet the immediate needs of agriculture, commerce, and transportation, through the medium of what has been called "applied meteorology." Meteorology for this purpose is defined as the branch of science that treats of the atmosphere and its phenomena, especially those that constitute weather.

Meteorological observations are made by the Weather Bureau for the purpose of forecasting the weather and for the accumulation of climatological data for direct application to every-day utilization and for material to be used in technical meteorological study.

In addition to the meterological work the Bureau observes the stage of the water in rivers and issues flood warnings and stage forecasts, and conducts studies in solar radiation.

The functions of the Weather Bureau are defined in the duties prescribed for the Chief of the Bureau in the original act approved October 1, 1890 (26 Stat.L. 635), section 3, as follows:

> The Chief of the Weather Bureau, under the direction of the Secretary of Agriculture, shall have charge of forecasting the weather; the issuance of storm warnings; the display of weather and flood signals for the benefit of agriculture, commerce, and navigation; the gaging and reporting of rivers; the maintenance and operation of seacoast telegraph lines and the collection and transmission of marine intelligence for the benefit of commerce and navigation; the reporting of temperature and rainfall conditions for the cotton interests; the display of frost, cold-wave, and other signals; the distribution of meteorological information in the interest of agriculture and commerce; and the taking of such meteorological observations as may be necessary to establish and record the climatic conditions of the United States, and such as are essential for the proper execution of the foregoing duties.

These activities are administered by project leaders stationed at Washington, D.C., through the agency of a large field organization embracing more than 250 permanent field headquarters located in every State of the Union, and elsewhere, and several thousand minor and cooperative stations with similar widespread geographical distribution.

HISTORICAL

The Weather Bureau came into being as a branch of the Signal Service of the War Department during 1870, under the provisions of a joint resolution of Congress approved February 9, 1870. This resolution authorized the Secretary of War to take meteorological observations at military stations throughout the United States and its Territories and to give notice by telegraph and marine signals of the approach and force of storms. This service was primarily for the benefit of navigation on the seacoast and the Great Lakes, but under a provision of the Appropriation Act approved June 10,

1872, it was extended so as to include the interior districts and the great rivers of the central valleys.

The benefits of the weather service were soon recognized by business industries and the general public, and its enlargement to include agriculture and commerce became necessary. This led to the conclusion that as a scientific bureau it could function better under civilian than under military control. Accordingly, on July 1, 1891, the Signal Service of the War Department was relieved of its meteorological duties and the Weather Bureau of the Department of Agriculture was organized and charged with the future of meteorology in the United States.

FORECAST AND WARNING SERVICE

Forecasts are based on regular observations of meteorological conditions taken daily at approximately 8 a.m. and 8 p.m., seventy-fifth meridian time, at about 300 observing stations in the United States, Canada, Alaska, and the West Indies, supplemented by reports from other countries and from ships at sea. When conditions warrant, special observations may be taken at other times and forwarded to a designated center from selected points. Observations are coded for the sake of brevity and economy and for speed in transmission. Through a special telegraphic system set up for the purpose, regular 8 a.m. and 8 p.m. reports are collected at New York and Chicago centers and redistributed to such field stations as require them in their daily service to the public. Transmission of a report to the collecting center or centers and its duplication and dispatch to field stations scheduled to receive it, requires less than 45 minutes. The reports are decoded at receiving stations and the meteorological information contained is made available promptly to the public.

General forecasts and warnings are based on meteorological data secured from these telegraphic reports of observations. Data are tabulated twice daily by expert chartmen and arranged for study and interpretation by experienced forecasters at district forecast centers located at Washington, D.C., Chicago, Ill., New Orleans, La., Denver, Colo., and San Francisco, Calif. Forecasts of weather and temperature and warnings of frosts, cold waves, storms, hurricanes, and other conditions are issued by districts for the entire United States and wind and weather forecasts for ocean areas adjacent to our coasts. Local and specialized forecasts are made at both district centers and local Weather Bureau stations. Forecasts and warnings are widely disseminated through the press and the mails, over the radio, and by telegraph and telephone, reaching practically every community in the United States and rendering useful service to the American public in nearly every phase of our national life.

CLIMATOLOGICAL SERVICE

The demand for a detailed knowledge of the climate of the United States and insular possessions led to the gradual development of an important and interesting feature of the Bureau's activities—the climatological service. In establishing a record of the climate, the Bureau uses its great body of observational data collected by thou-

sands of cooperative observers as well as its regular field personnel. These data are summarized and interpreted by qualified climatologists and comprehend a complete climatology of the country in the form of monthly and annual bulletins.

Special weather services are maintained during the growing season of the principal crops. Observations are made each morning at some 400 places in the grain and cotton areas. These are collected by telegraph, and released within 3 hours. A weekly service also is maintained for each State and for the country as a whole. Bulletins summarize the weather for the week and its effect on crop growth and farming operations.

RIVER AND FLOOD SERVICE

The basic work of the river and flood service is the determination of the relation of rain and snowfall to the amount of water carried by streams. In making this determination it is necessary to measure the rain and snow in the drainage basins of the country, measure the snowfall in the mountain regions, and gage the rise and fall of the water surface in the rivers. The information obtained is made available to power-development plants, irrigation projects, city water plants, and, in fact, all users of water carried by streams. In addition, it is used by the Weather Bureau in making daily river-stage forecasts and in the preparation of flood warnings. The daily river-stage forecasts are primarily for the benefit of navigation, but they are of value to a great number of other interests that are dependent upon a foreknowledge of the rise and fall in the streams.

The flood warnings, perhaps, are looked upon, especially by dwellers and property owners in overflow country, as the most valuable feature of the work. As soon as a flood forecast is made the dissemination of the information is begun. Telegraph and telephone warnings are sent to organized distributors, warnings are given to the press, and mailed to all post offices near the affected stream, and in the last few years they have been broadcast by radio. The radio is proving of inestimable value, for many farmers in isolated regions subject to overflow have inadequate mail and wire communication, and before the advent of the radio, flood warnings were sent to them with difficulty, or not at all. Now they have radio receivers and they listen for the daily river news with surprising regularity. Floods in small streams occur shortly after the rainfall that causes them, and rapid action is necessary to get worth-while warnings out to the threatened valleys. As a general thing, the larger the stream the longer the time that elapses between the fall of rain and the occurrence of the flood, and in the case of the extreme lower Mississippi Valley warnings are given a month in advance of the flood crest. The value of these warnings, especially in a year similar to 1927, is measured by the saving of many human lives and millions of dollars worth of property.

MARINE AIDS

In marine meteorology the Weather Bureau collects observations from ships at sea to determine weather conditions over the oceans. Observations are made by masters and officers of the

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world's merchant marine without other compensation than the receipt of pilot charts and other publications free. The data are charted, compiled, and studied in the interest of navigation and meteorology and form the basis of the meteorological information given in the pilot charts issued by the Hydrographic Office of the Navy Department, in cooperation with the Weather Bureau, under provision of an act of Congress approved June 16, 1910.

Extensive service is rendered by the Weather Bureau in the aid of navigation. Forecasts of wind and weather and warnings of storms at sea are predicted on the regular collections of reports from land stations and observations received twice daily by radio from ships. Storm warnings, flags by day and lanterns by night, are displayed from steel towers and flagstaffs located at every harbor of any considerable importance along the Atlantic, Pacific, and Gulf coasts, and on the shores of the Great Lakes. Bulletins for the benefit of ships at sea, containing weather information and forecasts, are disseminated, principally by radio, regularly twice a day and more frequently when severe storms are in progress. These bulletins contain reports of actual weather conditions on land and ocean areas, the location of storm centers, their intensity, and forecasts of speed and direction of movement.

BUREAU AIDS IN FOREST-FIRE PREVENTION

To help in preventing forest fires, specialists are employed in the heavily forested areas of the far Western States, the upper Lake region, New England, and the southern Appalachian region. Surveys determine topography, elevation, ground covering, and other factors, as these affect wind direction and force and atmospheric humidity. These surveys, with current local weather data, furnish a basis for intensive, localized forecasts and warnings as to the fire hazard.

SOLAR RADIATION

Solar radiation is studied by the Weather Bureau. This work involves measurements of the intensity of the radiation, or heat energy, received at the surface of the earth directly from the sun and diffusely from the sky; the construction and standardization of apparatus for such measurements; studies of the depletion of solar radiation by the gases, including water vapor, and the dust of the atmosphere; finally, the expenditure of the radiation that reaches the surface of the earth, including its effect upon air temperature.

HORTICULTURAL PROTECTION METHODS

In the Bureau's fruit-frost service specialists cooperate with fruit growers in protecting their orchards. The work consists of making temperature surveys to determine the relative susceptibility of different localities to frost, issuing forecasts and warnings, experimenting to determine the most effective and economical methods of protection, and giving advice to growers as to heating requirements to prevent frost damage. The specialists study the thermal relations of different localities of their districts and make each day, during the danger period, a very definite forecast of the lowest tem-

perature expected during the ensuing night. Fruit growers are notified through a special system of communication. This service was originally conducted principally in the far West, but recently has been started in the east Gulf section and the lower Rio Grande Valley.

A special fruit-spraying service is given in several important fruit-growing districts as a guide in the application of sprays to trees. The efficiency of sprays, both as insecticides and fungicides, is largely determined by their being applied under proper weather conditions. Orchardists therefore need information as to coming weather conditions. The project is intensively organized and conducted in New York and to a lesser degree in other important apple-growing States. A similar service is conducted as an aid to farmers during harvesting operations.

AEROLOGICAL INVESTIGATIONS

The upper-air observations are made by means of airplanes and balloons. Until recently, kites also were used but these have been abandoned, owing to the great superiority of airplanes for this purpose. The observations with airplanes are made at present at four stations only and provide information daily concerning temperature, humidity, pressure, cloud heights, and cloud thickness, up to 15,000 to 20,000 feet.

Upper-air wind velocities and directions are determined from 2 to 4 times daily at about 70 Weather Bureau stations. For this purpose, pilot balloons are released and observed through a theodolite. Since these balloons are inflated to a definite "lift" they rise at a known rate and from the elevation and azimuth readings made each minute the wind velocity and direction are readily determined.

Sounding balloons are released on special occasions for obtaining temperature, humidity, and pressure data at heights up to 15 miles and sometimes greater. These balloons are about 5 feet in diameter and carry a self-recording instrument which descends by means of a parachute after the balloon bursts.

The data secured by the methods above outlined are used in giving current information concerning upper-air conditions to pilots; in providing valuable aids in forecasting, both for general public needs and for aeronautics; and as a basis for technical studies designed to increase the effectiveness of the service.

SERVICE FOR AERONAUTICS

The rapid development of flying activities in the past few years has necessitated the organization of a specialized service to take care of this need. Provision for the service is contained in section 5 (e) of the Air Commerce Act passed May 20, 1926, which is summarized as follows:

The Chief of the Weather Bureau under the direction of the Secretary of Agriculture is to (a) furnish such weather reports, warnings, and advices as may be required to promote the safety and efficiency of air navigation in the United States and above the high seas, particularly for civil airways designated by the Secretary of Commerce, under authority of law as routes suitable for air commerce, and (b) for such purposes to observe, measure, and investigate atmospheric phenomena and establish meteorological offices and stations.

As provided by this authority, a detailed network of reporting stations has been organized and is now in operation along the principal Federal air trade routes. Reports of weather conditions are transmitted hourly to central stations of the Bureau at important terminal airports, and there used by trained meteorologists as the basis for summarized statements and short-period forecasts which are broadcast by the Department of Commerce radio stations, thus being made available to aircraft in flight as well as to interested persons on the ground. This service is supplemented by the longer period forecasts, issued from the Bureau's five district forecast centers, which give the expected changes in conditions for comparatively large areas during the following 12 to 24 hours and which are therefore expressed in general terms.

OTHER INVESTIGATIONS

While the work of the Weather Bureau is primarily devoted to responding to the daily needs of the public, it is also giving attention to the need of development of the higher scientific work necessary to assure advancement in the art of weather prediction and improvement of the general service activities.

Specialized studies looking to the improvement of the forecasts and warnings have been made, such as investigations of the movement and development of barometric depressions, using as a basis observations in the free air of temperatures and humidities as obtained from kites and airplanes and the wind directions and velocities derived from pilot-balloon observations. Studies have also been made of the processes of rain formation as associated with the " fronts " of the Bjerknes school. Other investigations have involved the origin and birth of primary and secondary disturbances that affect the weather of the United States. Some of the above studies have been published in the Monthly Weather Review and elsewhere.

Studies have also been made to determine sky brightness, or the intensity of natural lighting in various sections of the United States, at different seasons of the year and hours of the day, and under various atmospheric conditions.

PROGRESS

In the earlier years of its existence the Weather Bureau depended almost solely upon surface conditions, principally on land areas, for the observational material on which to base its forecasts, climatological summaries, etc., the one exception being the observation of clouds—their amount, movement, frequency, etc. It was soon realized that the lack of information as to changes taking place in the atmosphere above the earth's surface constituted a serious handicap; in other words that meteorology is essentially a three-dimensional science. As rapidly therefore as funds for the purpose were made available action was taken to investigate the free air. Observations in the upper air were begun by the Bureau about 25 years ago. At first they were made by the use of kites—as time went on other means were introduced, including captive, sounding, and pilot balloons. Recently, and to a greater extent as time goes on, the airplane is also used for this purpose.

When Marconi began his investigations in wireless telegraphy in 1895 the Bureau immediately became interested because wireless communication presented a field of opportunity to procure current weather information from places inaccessible by wire communication facilities, and the transmission of forecasts and warnings. Radio is now indispensable to the functioning of the weather service. At the present time weather reports are obtained daily by this means from the Far East, our territorial possessions, Iceland, Greenland, Europe, and thousands of observations are received from ships at sea. Forecasts and warnings of interest to mariners are broadcast daily, and every opportunity is being taken to use radio for the purpose of communicating weather information to farmers, for which purpose it bids fair to outstrip all other means of communication.

By the means of the foregoing and in other ways the Bureau has, within the past few years, extended the area from which meteorological reports are received to cover practically the entire Northern Hemisphere. The greater survey of atmospheric conditions afforded by these reports has made possible improvement and extension of forecasts and warnings.

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